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NATIONALIZATION OF THE A. I. E. E.

President Lieb, in his very able Asheville address, treating largely of problems confronting the American Institute of Electrical Engineers, very properly laid stress upon the eminent desirability of imparting to that body in the fullest sense of the word the character of a truly national organization. That the Institute is by many of its members not resident in New York and vicinity considered weak in this respect is a matter of common notoriety, the most frequent criticism being that the Institute has been administered more as a New York local society than as a body purporting to be the representation of the American profession at large. It is true that the great preponderance of membership in New York and vicinity would give that section a natural predominance in the conduct of the Institute, even with the headquarters located elsewhere; but when it comes to a matter of sectional feeling, the aggrieved are little apt to give heed to considerations which they may consider work to their disadvantage. The fact must be recognized that a feeling does exist that the honors and prerogatives of the American Institute of Electrical Engineers have been too largely monopolized by its New York members, and anything that can be done to obviate or lessen this feeling will strengthen the body as a truly national organization. While under normal circumstances the discontent may not seriously affect the Institute in a material way, yet in the pinch of hard times it may be the deciding factor leading to resignations of members who might resort to some other sacrifice if they considered the act would separate them from visible fellowship in the profession at large as represented by a body of unquestioned national character.

As stated above, one of the principal reasons for the discontent to which we refer is the monopolization by New York of the offices in the gift of the Institute, and on this point President Lieb recommended a change in the Constitution whereby the selection of nominees would lie with a committee having a membership representing the different sections of the country. Without discussing the merit of this suggestion, we are very strongly of the opinion that before any new means of correcting the evil complained of be adopted, the clauses now in the Constitution specifically framed to meet this very evil be enforced instead of deliberately ignored as at present. Nothing can be more explicit than these constitutional provisions, and if they have not been executed, what assurance is there that substitutes therefor would meet with a better fate? The provisions to which we refer are one requiring a geographical distribution of the vice-presidencies and another providing for an official representation of various sections of the country by delegates at the general meetings of the Institute. In the article of the Constitution regulating the election of officers, it is rendered mandatory on the Board of Directors in making up the list of director nominees "That the names for the office of vice-president shall be selected with a view to maintaining a geographical distribution of incumbents of this office." This provision has almost uniformly been flagrantly violated, the offence at times going so far as the selection of New York members for the official ticket who received a less number of nominating votes than out-of-town members. As to the requirement relating to official representation at general meetings, of bodies of membership in various sections of the United States, one of the eleven articles of the Constitution is devoted entirely to this matter, describing the manner in which the country shall be divided for this purpose,

the method of selection of the delegates and defining their duties and privilege. This article has thus far remained a dead letter, and by-laws which have been proposed to render its execution compulsory have been rejected. With unexecuted provisions in the Constitution so specific as the above in the interest of the general membership of the Institute, we fear the tender of an olive branch in the form of yet another "safeguard" might cause the motive behind it to be impugned, or the offer even regarded as a mockery.

THE SUBWAY AS A CALORIMETER.

The New York Subway has been the subject of many characterizations commendatory and damnatory, prayerful and profane, but never in our wildest dreams of linguistic eccentricity did we expect to hear it called a calorimeter. We are mindful of the Billingsgate fisherwife, long skilled in fervid vituperation, whom Sidney Smith once reduced to stuttering impotence by calling her a parallelopiped. One of our esteemed contemporaries has, however, accomplished the impossible and with solemn iteration of misapplied data has sought to exploit the much abused hole in the ground as a new kind of calorimeter, the recipient of boundless stores of energy, and only escaping the temperature of an electric furnace by the magnificent system of ventilation provided by the station stairways. Moreover, he continues with weighty figures to show how perfect the air supply must be to escape melting down the passengers, to say nothing of the rails. We wonder what were his reflections on the possible saving of heat that a little ingenuity might accomplish. Why not provide air valves at the stations and recover the precious energy? A few lengths of iron pipe along the subway roof would make a capital feed-water heater, and an escape valve leading the heat back to the power houses might help to keep up the temperature of the flue gases. Why thus trifle with the good public that daily faces the reek of it and try to show that the air is completely changed every seven minutes? Have you a cold in the head, to thus deny the evidence of myriads of noses? Pray no more of hot air, and rouse no more fears of wholesale deflagration! One might as well try to evaluate the temper of a mule by the working radius of his hind leg as the ventilation of the subway by the temperature it does not assume. There is plenty of energy converted and misconverted there, but it is not all taken out according to the ventilation program, more's the pity.

DURATION OF HIGH-TENSION INSULATION TESTS.

In a paper on the apparatus and methods of testing insulation read at the Denver National Electric Light Convention, Mr. C. E. Skinner discussed the mooted question of the duration of high-tension tests. There can be no doubt that long applications of high electric stress are capable of reducing the electric strength of the tested machine in at least three ways. Firstly, the air in and around the parts tested becomes ionized and partly loses its natural dielectric strength. Secondly, the heating produced by dielectric hysteresis within the mass of a powerfully stressed insulator, abnormally weakens its insulation. Thirdly, the powerful dielectric stress is capable of producing either physical or chemical alterations in the substance of an insulator, which alterations may be extremely slow at normal electric intensities; but which may proceed rapidly above a certain critical electric intensity. This process is a sort of electric distillation, and is capable of destroying dielectric strength. On removing the high testing pressure, the first and second causes of weakening tend to disappear, the ionized air by diffusion and the internal heat by conduction, but the substantial changes produced by the electric distillation are not likely to disappear, and probably effect a permanent reduction in the dielectric strength. For these reasons all high-pressure applications in testing should be of brief duration when the intensity is considerably above the normal.

THREE-PHASE MOTORS FOR TRACTION.

It is rather interesting to note from the Asheville meeting a pair of very able papers by Mr. De Muralt and Mr. Waterman, on the application of three-phase motors to traction. Of late it has been rather the fashion in this country to speak of three-phase traction as a species of dead cat once tolerated, but now cast upon the ash heap. Cats, however, by immemorial tradition have nine lives, and to judge from the papers in question, the supply is far from exhausted. To be sure, there are no three-phase roads in this country; but on the other hand there was more money in exploiting something else, so that it can hardly be said that any alternating system has had a fair chance as against standardized apparatus. The two papers in question take up the problem along different lines, Mr. De Muralt dealing exclusively with heavy traction and Mr. Waterman taking up suburban and interurban traffic requiring high acceleration, a field in which direct-current motors have been supposed to hold unquestioned sway. They reach substantially similar conclusions, to the effect that in each case the three-phase motor has a material advantage in initial and in operating expenses. As might be anticipated, this advantage is somewhat greater in the case of heavy traction with relatively slow acceleration and comparatively infrequent stops. In the particular concrete case examined by Mr. De Muralt—a road having 224 miles of single track and doing considerable freight haulage—the first cost of the installation with three-phase machinery was almost exactly two-thirds of that for direct-current apparatus, while the difference in efficiency and consequent power consumption rose to nearly 20 per cent. in favor of three-phase.

This instance is perhaps unduly in favor of the three-phase system, just as divers similar calculations by certain other engineers have been for assumed conditions intended to favor direct-current methods. It is very easy to draw criteria against one system or the other—for example, to demand a single trolley wire as a *sine qua non*, or to insist upon low voltage in the moving coils upon the other hand. Mr. Waterman, on his part, makes a frontal attack on the direct-current stronghold of suburban service. The illustrative case taken is that formulated by Mr. Berg some time since as a defence of things as they are, and Mr. Waterman's result is a gain of 12 per cent. in cost and of 3.8 per cent. in energy required in favor of three phase. The point of the matter is that Mr. Waterman chose for exactly the same service demanded by Mr. Berg a value of the acceleration and a general method of making the run especially suited to his three-phase motors instead of assuming that alternate and direct-current motors must not only attain the same results, but must be worked just alike in doing it. Also he laid out a motor design to suit the case without regard to following direct-current precedents. He can hardly be claimed to have routed the direct-current forces horse, foot and dragoons, but he most assuredly has carried some important outworks. The one really material objection to three-phase traction is the necessity for two or more trolley wires. This disadvantage must be taken into account seriously, but it is a notable fact that many foreign engineers do not consider it as of much moment. In fact, Mr. De Muralt asserted, in reply to a statement that the use of two trolleys in the New York Central terminal yard would be impossible, that no difficulty is experienced in

Italy, where the Valtellina terminal yard, though much smaller, is more complex than that of the Central. Incidentally, Mr. De Muralt pays his respects to the new single-phase machinery, which he regards as operatively inferior, and to the Ward Leonard system, which he looks upon with some favor. Altogether the discussion is a very interesting one as showing the good features of systems unfamiliar to American practice. Of course, whatever may be the merits of the case, the direct-current machinery has possession of American electric traction, and possession is nine points of the law. Nevertheless, it is a good thing to realize that other people, who broadly know their business as well as we do, go about it in a different way, and seem to obtain very satisfactory results.

THE ECONOMIC EFFECT TO BE EXPECTED FROM THE GENERAL INTRODUCTION OF METALLIC FILAMENT INCANDESCENT LAMPS.

Although the tantalum and osmium incandescent lamps have not yet come into commercial use in this country, yet it seems likely that they are destined to arrive in the near future. Already both of these types are stated to be in fairly extended practical use in Germany, particularly the tantalum lamp, although it has not yet been placed commercially on the market. There has not yet been sufficiently extended experience with the tantalum lamp to determine what it can accomplish in commercial use. There is no doubt as to its capability of giving a high initial candle-power with a given energy consumption. That is to say, its specific consumption may be made as low as 1 watt per mean horizontal candle, without destroying the filament, and tests are now on record which show that at 2 watts per candle the lifetime of the lamp is satisfactory. What remains to be ascertained is the price at which the lamp can be bought and the average lifetime based on extended experience. It seems safe to assume, however, that since the amount of tantalum which enters into the filament is only a couple of centigrams, and that tantalum ores are by no means rare, there should be no serious expense to apprehend for the purchase of the metal. Even at the price of gold, the cost of the filament in a 110-volt, 25-hefner lamp would be only a little over one cent. There is more rigging in a tantalum lamp than in a carbon lamp; but on the other hand there is no flashing process to be conducted on the former, so that the only uncertain element of expense seems to be the royalty. As regards the specific consumption, 2 watts per candle on the average, or 1.85 watts per candle initially, may be accepted as a provisional estimate. If, then, all the existing 3.1 watt-per-candle carbon lamps were replaced by 1.85 watt-per-candle tantalum lamps and no other change were made, the income from lighting derived by central stations would fall 40 per cent. The question is, What are the forces tending to bring about this result, and how far may the deficit be met by the central stations?

Even if the tantalum lamp were out of the question, improvement in the efficiency of the carbon lamp is likely to be effected. The question is not merely electrical—it is largely economic or sociological. It has happened repeatedly that manufacturing improvements have reduced the price of a certain commodity. At first sight, one would suppose that the community would purchase only a little more than before, and the total money value of the sale would decline. In most cases, however, after a period of readjustment has elapsed, the community buys as much more of the same commodity as will make up for the difference in price, or else buys the same quantity of a previously more expensive quality of the commodity. The community seems to act in many such cases as though it set aside the old established amount of money for the purchase of the commodity, and when the price lowered it spent the same money on more of the same kind, or the same amount of a better kind. Sugar is a noted example of this peculiarity of custom. Not many decades ago, the sugar consumed in households was of the brown or crude variety. The whitened or refined sugar was relatively so expensive that its sale was small. Owing to improved processes of manufacture, the prices of both crude and refined sugar suddenly declined. Instead of saving the expense, as was predicted by many, and buying the same quantities of sugar at the reduced rates, it was found that the sales of sugar remained nearly the same in money value, but that the sale shifted from crude sugar to refined sugar. In the same way it is reasonable to expect that the existing consumers of electric light will be readily persuaded to take the advantage of the reduced price of light in light instead of in money. Not only would they be willing to replace 16-candle-power lamps by 22-candle-power lamps, but they would also be less likely to pay as careful attention to the turning off of lamps immediately the need for them was reduced. They would burn more powerful lamps and longer hours. Moreover, the reduced price of electric light would be a strong argument favoring the introduction of electricity into houses that at present use only gas. In this way, a large market will be derived for electric power consumption. Taking both these influences into consideration, we do not hesitate to predict that the reduction in the cost of electric incandescent light will eventually benefit both the customer and the central station.

A very similar state of things has occurred in the gas industry attending the introduction of the Welsbach mantle. It is asserted that this mantle doubles the candle power of a gas jet, at the same time that it halves the gas consumption, so that it gives four times the light that could previously be obtained per cubic foot of gas. The results of this change have not yet had time to determine their steady state; but whereas the average gas burner used to give 12 to 16 horizontal candles, it is now commonly of 25 candles, and Welsbach burners are commonly of from 40 to 80 candles. It is easy therefore to see that the public are prepared to take the advantage out in gas. A question which arises in this connection is as to whether it would not be advisable commercially to raise the standard of candle power for lamps of the improved type. Thus the German standard tantalum lamp seems to have 25 mean horizontal hefners or 22 mean horizontal British candle-power. To adopt this rating would be to simplify the matter and to enter into continental practice. Moreover, it would introduce the hefner as a commercial standard without any upheaval or difficulty. If a change in the standard rating of lamps is opportune, it might just as well be made in terms of a new unit. The British standard candle is a mere time-honored figment of the imagination embalmed in phraseology, a fond thing vainly invented. As a concrete standard it is as extinguished or extinct as the dodo. That it was originally a satisfactory standard in the days when there was nothing better, is not to be denied, and it served its purpose generously. At present its memory should be only preserved along with its ashes. The hefner is practically the only working standard of light all over the world. In order to have our incandescent lamps rated in candle power we first have them measured in terms of the hefner and then multiply by the magic constant 0.88, whose brevity covers a multitude of sins. This time-honored farce would terminate if we adopted the hefner as a commercial standard. No consumer is likely to object at having his 22 candle-power lamp rated at 25 in the new units, and the industry would gain in precision and in international usage.

Proceedings of Asheville Meeting of A. I. E. E.

By Telegraph.

The twenty-second General Meeting of the American Institute of Electrical Engineers at Asheville promises to be a great and memorable success in the technical sense, although in point of attendance it may not equal many previous meetings. The prejudice against southern resorts at this season operates naturally to prevent a large muster, and the hot weather may have weakened the intentions of many. The attendance on Monday morning was around one hundred and fifty and bids fair to touch two hundred. This beautiful mountain side is, perhaps, as cool a spot as could be found at the season. Its temperature is very grateful after the hot and dusty journeys from various points. About a score of ladies are present, and several southern cities are represented, especially Atlanta, whose local branch has turned out strongly.

Monday morning's session opened promptly at 9:30, when Mayor Barnard, of Asheville, delivered an admirable address of welcome, saying that the city enjoyed new distinction as the first to be visited in the South by the Institute. Commenting on the growth of electricity and of the South, he spoke of the Institute as typically one of the organizations and forces doing more than any other to break down sectional and geographical barriers and misunderstandings. The country at large and the region they were in owed much to the great electrical art. President Lieb replied gracefully, and then read his presidential address, which was regarded as a most forceful document from which many new points of departure in Institute work and development might be recorded.

The paper by Dr. Steinmetz on "High Potential Oscillations of Large Power Distribution Systems" and that of Mr. Percy H. Thomas on "An Experimental Study on Commercial Transmission Lines of the Rise of Potential Due to Static Disturbances, Such as Switches, Groundings, Etc.," were then read and taken up for discussion together, being heard by a very large audience. The following discussion was long and excellent. Mr. H. G. Stott commended the liberal spirit shown in approaching the subject by the authors and the dismissal of mere commercial considerations. As regards Interborough practice in New York, he pointed out what had been done to obviate repetition of such occurrences. The principal items are the grounding of the neutral points of the generators and enclosing all cable so as to prevent the possibility of an open air arc. The cables are thoroughly enclosed in ducts, so that the only weak points are the manholes. Besides being wrapped with asbestos strip one-quarter inch altogether the cables are enclosed each one in an iron case, and they can then safely stand any short circuit long enough to let the automatic relays cut out the cable. Mr. Thomas and Dr. Steinmetz both approved of this practice as being a valuable and sure preventive. In discussing the paper of Dr. Steinmetz, Mr. Thomas did not quite agree with the theory of the whole trouble being due to an oscillatory open air arc, but said it was a case of resonance caused by one conductor grounding first and then being burned off. He elaborated this and also pointed out the great importance of opening all three phases of the circuit simultaneously. That must be put down as a positive maxim for all such power work. Dr. F. A. C. Perrine concurred broadly with Dr. Steinmetz and made a general discussion. Mr. P. N. Nunn contributed some rather startling remarks. He held that the generators, transformers and switching gear had now reached a state of great perfection and were more reliable than corresponding steam apparatus. But the transmission lines were not reliable, but were lamentably far behind. No one knew the conditions obtaining on them exactly from moment to moment of the varying operations of the plant. When approached by capitalists to recommend very long transmission lines, he felt it better to be perfectly frank in stating that at present such work was to a great extent unreliable and experimental.

The paper by Dr. Steinmetz on "The Constant-Current Mercury-Arc Rectifier" was then read, and elicited an interesting discussion. The general opinion was expressed in the discussion that it was a highly useful and important development. Dr. Steinmetz said he had written the paper purely from an engineering standpoint and not on a metaphysical basis, and had found he could treat the subject as a pure problem of the arc, without relation to theories. President Lieb spoke of the importance of the appliance in relation to a large variety of service, and all service to derive current supply from one common central source or system. Dr. Steinmetz spoke of the preferability of the pulsating arc over the old continuous arc, thus going back to early Brush practice, his point being that the mechanism of the arc lamp was assisted. Mr. John W. Howell in an interesting discussion spoke of the remarkably high efficiency of current conversion into light by the mercury arc lamp. Dr. Perrine made some historical remarks, crediting the invention to French origin rather than American.

The first paper read at the evening session of Monday was that of Mr. Henry W. Fisher, entitled "Data Relating to Electric Conductors in Cable," which was discussed by Messrs. H. G. Stott, Calvin W. Rice, C. O. Mailloux, Dr. F. A. C. Perrine and Dr. C. P. Steinmetz. Dr. Steinmetz warmly recommended the paper, but disagreed with the author as to the effect of increased impedance in a cable containing a central steel strand, which would not tend to compensate the capacity since it introduces series reactance, while capacity is a shunt reactance. There would be, moreover, an increased tendency to resonance and increased frequency of surgings. Mr. Fisher in answer to a question by Mr. H. G. Stott said that capacity as shown by a galvanometer test is greater than true capacity indicated by a charging current, because polarization occurs when the cable is hot, producing a sort of return current; also that the cause of heating when a certain ratio mentioned in the paper is small is dielectric hysteresis, so-called.

The paper by Prof. S. M. Kintner entitled "Methods of High Pressure Measurement" was then read. In the discussion Dr. Steinmetz favored the use of the spark gap instead of the static voltmeter for high potential testing, and pointed out that the voltmeter measures mean effective voltage and not electrostatic stress, while the spark gap measures the latter regardless of wave forms. Shields should not be used because they modify the electrostatic stress between electrodes. Loose contacts in series must be obviated as they may cause the gap to become a Hertzian oscillator and reduce the break-down voltage. Dr. Samuel Sheldon said he had found the spark gap greatly influenced by proximity of other parts of the conducting system. Mr. C. O. Mailloux agreed with Dr. Steinmetz as to the greater reliability of the spark gap, and said that certain curves in the paper were in fact composite parabolas, as was to be expected. Mr. Stott said that in commercial work the spark gap had proved unsatisfactory, and that in such work the static voltmeter was much to be preferred. Mr. Fisher pointed out that with perfectly sharp points the spark gap is reliable, but with one or both slightly dull this is not true.

Mr. John W. Howell then read his paper entitled "Some Comments on Remarks Made by Colonel R. E. B. Crompton Before the International Electrical Congress at St. Louis," who had referred to British high-voltage lamps as more efficient than American lamps of the same voltage. Mr. Howell gave the result of tests of British lamps, which were found not to be equal to lamps of American manufacture. President Lieb explained the occasion of the remarks of Colonel Crompton. The final paper of the evening was presented by Mr. C. E. Waddell, the title being "The Preservation of the Southern Streams—A Forest Problem." All important water powers in the South Atlantic States are, he said, on streams arising in the Appalachians, and the water

power on these streams has been greatly impaired by extravagant timber cutting. More conservative lumbering methods are necessary to preserve the value of these water powers. The paper was illustrated by lantern slides, and owing to the lateness of the evening there was no discussion.

The session of Tuesday morning was opened by the reading of the paper by Mr. F. N. Waterman on "Three-Phase Traction," which was followed by an interesting discussion. Mr. W. W. Smith criticised the use of motors running at constant speed on the ground that the weight would be greater than in the case of direct-current motors giving constant power with varying speed. He also thought that the ratio of the dead to the live load on a train would be much higher with three-phase than with either direct current or alternating current series motors. Mr. Steinmetz said that in applying three-phase motors to traction there are many problems to be solved which were not encountered in the Valtellina system, which is a relatively small one. On a trunk system it would not be allowable to have generator speed and consequently frequency pulled down by heavy trains on a steep grade. Two overhead conductors in a complex switching yard like that of the New York Central would be a serious handicap, and the low frequency of 14 cycles is impracticable in view of the magnitude of existing plants using present commercial frequencies. Mr. C. O. Mailloux believed that the three-phase system is applicable under some special conditions existing in Europe, but not in this country. The double trolley wire and small motor air-gap are fundamental objections. Mr. H. G. Stott pointed out that the cost of operation is not proportional to kilowatt-hours alone; the cost per kilowatt-hour is inversely proportional to load factor, so that a small saving in kilowatt-hours per ton might be unimportant. Mr. C. de Muralt said that on a system of any extent a single train on a grade would not affect other trains. The three-phase system would naturally be used only for long distance work on roads operating many trains.. A three-phase motor is lighter than a direct-current motor of the same output and heating. As to the objection to the double trolley, he said that the terminal yard of the Valtellina system is more complex than that of the New York Central, though not so large. Mr. F. N. Waterman said that the total weight of a car equipment with three-phase motors does not exceed the total weight of a direct-current car equipment under the same operating conditions; moreover, experience on the Valtellina system had proved that a small air gap was entirely practical.

Mr. C. de Muralt then read his paper on "Heavy Electric Freight Traction." In the discussion Mr. Mailloux contended that while induction motors could be built for a high acceleration and overload capacity, the cost would be prohibitive. He knew of none built for an acceleration above 1.1 miles per hour per second. Mr. S. T. Dodd believed that the difference in wheel diameters due to wear would render three-phase, multiple-unit operation impracticable because motors would run at different speeds and affect load distribution. Mr. F. N. Waterman stated that within reasonable acceleration limits the cost per kilowatt-hour per ton-mile is less with three-phase than with direct-current and becomes more favorable with higher acceleration rates. There is no difficulty or excessive cost involved in building three-phase motors to give 2.5 miles per hour per second acceleration. Mr. Steinmetz thought that while the author's conclusions were right, his premises were doubtful. He asserted that induction motors to give high acceleration and great overload are costly, and have a very poor power factor at rated load. With rotors and collector rings ample for heat radiation, he stated there is no room for increased bearings required by small clearance. Returning power to the line increases instead of decreases station load fluctuations, and it had been proved by experiments with direct-current motor equipments that returned current is not worth the complication involved. Three-phase motors cannot return power to the system unless they are connected in concatenation, in which case the low efficiency causes excessive heating. Mr. De Muralt replied that with an overload capacity about three times the rated load, the power factor at rated load can be kept high.

Mr. S. T. Dodd then presented his paper entitled "Weight Distribution on Electric Locomotives as Affected by Motor Suspension and Draw-bar Pull." In the discussion Mr. Mailloux commended the paper highly. Mr. Waterman pointed out that Mr. L. B. Stillwell had previously called attention to differences in the slipping of different wheels on the same Manhattan car, but thought that the author's work had a valuable bearing on that difficulty.

As the programme for Tuesday morning was not finished at the hour of adjournment, it was decided to hold an extra evening session. The first paper presented at this session was that of Prof. William McClellan, entitled "Choice of Motors in Steam and Electric Practice." Mr. Steinmetz thought that rather than to attempt to put forth a new system of standardization, the motors already standard and found reliable should be adopted. Mr. Mailloux agreed that standardization of electric locomotives is not yet practicable, but disagreed with Mr. Steinmetz on the general principle of standardization, as he considered constant experiments with, and trial of, new systems necessary to progress. Mr. C. F. Scott disagreed with the author and stated as an illustration the fact that engines for the subway power house, though ordered as duplicates of the Manhattan engines and built immediately after, were radically different in important constructional features. He thought it useless to consider standardizing electric locomotives at the present time, and added that the author was about a half century too early with his proposition.

The paper by Mr. L. H. Thullen entitled "Electric Features of Block Signalling" was then read. The paper was supplemented by Mr. Scott with a very full description of the fundamental features of the New York Subway signal system, which, he said, had a record of 300,000 performances with one failure. Mr. Waterman pointed out the enormous difficulties confronting engineers who devise subway signal systems, and said that the Pennsylvania Railway System had previously held the record, which was 70,000 performances with one failure. The meeting then adjourned.

The morning session of Wednesday was opened by the presentation of the paper by Mr. Thorburn Reid, entitled "Limit of Injurious Sparking in Direct-Current Commutation." In the discussion Mr. Gano S. Dunn said Mr. Reid's theory is the best thus far proposed, but it does not cover all observed facts. He had noticed a deposit of copper on brush faces negative to the commutator, apparently due partly to electrolytic action on copper volatilized by excessive energy density under brush face. The blackening of commutators, however, is due to high energy density at leaving edge of brush, and may be entirely eliminated by a composite brush, consisting of the usual brush and several "dead" brushes, insulated both from the collecting brush and from each other. Dr. Steinmetz and Mr. W. L. Waters agreed with Mr. Reid's theory as to effect of excessive energy density under brushes, but the former pointed out that brush contact resistance is not constant as assumed in the paper, but varies with commutator velocity and brush pressure and inversely as current density. With fixed velocity and pressure, the voltage drop is practically constant.

The paper by Prof. C. A. Adams, entitled "A Study in the Design of Induction Motors," was then read. In its discussion Mr. Waters criticized the method of calculating magnetic leakage as too complex for practical work, and said that an experienced designer can estimate leakage about as closely as anyone can calculate it. Dr. Steinmetz said that the calculation of leakage is necessary and that

the Adams method is practical and valuable, especially when reduced to simpler forms for specific types of machine. The paper by Mr. Sebastian Sentius, entitled "Limitations in Direct-Current Machine Design," was then read. Messrs. Dunn, Waters and Steinmetz disagreed with the author as to the limits of direct-current machine output, and cited cases of actual machines much beyond the author's limits set in the paper. Dr. Seinmetz pointed out that the author's method and formulas are limited to a specific machine type and are not generally applicable. The formulas are not even approximately accurate when a brush covers several commutator bars. The maximum average current density from the brush face is no criterion of output, which is limited by the maximum density where the density is greatest. The paper by Mr. A. B. Field, entitled "Eddy Currents in Large Slot-Wound Conductors," was read by title, and followed by the paper of Mr. E. F. Northrup, on "A New Instrument for Measuring Alternating Currents." Mr. Northrup's paper was discussed by Messrs. H. W. Fisher, H. G. Stott, R. N. Waterman and Profs. Morgan Brooks and Perkins. In the discussion Mr. Northrup brought out a few additional details. Mr. W. L. Waters then presented his paper entitled "Motor-Generators and Synchronous Converters." Mr. Gano S. Dunn rather favored the motor generator over the rotary converter. Mr. Prout thought that the specific advantages of the induction motor are more imporant in practice than the better power factor of the synchronous motor forming part of a motor generator. Dr. Steinmetz disagreed with the author as to the armature reaction of rotary converters. High reaction is preferable for the reason that it involves less liability to hunting. Both rotaries and synchronous motor generators will hunt, but rotaries much less than the latter.

High armature reaction enables the converters to carry greater overloads and makes its control easier under fluctuating loads. Mr. Stott considered that rotaries and motor-generators cost practically the same, every factor being taken into account. Rotaries allow better regulation on the distributing system because heavy load fluctuations cause cumulative variations in the power factor of the motor of a motor-generator. President Lieb said anti-hunting and speed-limit devices had been found necessary on the rotaries used by the New York Edison Company. Short circuits on alternating-current systems caused runaways before speed devices were used. Dr. Steinmetz said that the rotary cannot race if connected to an alternating system of relatively large output, but both rotaries and motor generators will race under short circuits, the latter being more affected. Mr. Dunn disagreed on the latter point. Mr. Waters pointed out that shunt machines would not run away, and in lighting service motor generators would usually be shunt wound. The session then adjourned.

Later arrivals have brought up the attendance at the meeting to about 250, including very many well-known members. A visit was paid on Tuesday afternoon to the Weaver water power plant, which feeds into the electric system of Asheville and is a good illustration of the possibilities in North Carolina for water power generation and transmission. While there members were shown in operation a new form of turbine governor invented by Nathaniel Lombard and made by the Holyoke, Mass., Machine Company.

On Tuesday evening there was a reception and a ball, which was largely attended by Asheville people as well as by members. On Wednesday afternoon there was a trolley ride and a reception and tea at the Asheville Golf Club. Wednesday evening was given up to the banquet, at which nearly 200 were present. The main dining-room of the hotel was beautifully decorated. A large badge of the Institute in incandescent lamps, wired on the Elblight system, presented a fine appearance. Festoons of blooming cotton, rhododendrons and battle flags completed a beautiful spectacle. President Lieb opened the postprandial ceremonies by an address highly complimentary to the South, which was responded to by Mayor Barnard with similarly complimentary references to the Institute and to the visitors. Dr. Schuyler Skaats Wheeler responded to the toast "The Institute"; Dr. Charles Proteus Steinmetz to "Theory and Practice"; Dr. Samuel Sheldon to "Technical Institutions"; Mr. John H. Finney, of the local committee, to "Industrial Development of the South," and Dr. F. A. C. Perrine to "The Utilization of Natural Resources Through Electricity." Mr. T. Commerford Martin acted as toastmaster. Mr. C. E. Waddell is highly praised for his great share in the admirable arrangements for the entertainment of the Institute. On Tuesday evening Mr. Waddell gave a dinner at his home to some of the officers and leading members of the Institute.

National-Interstate Telephone Association.

By Telegraph.

The consolidation of the National Independent Telephone Association and the Interstate Independent Telephone Association to form a really national organization, has resulted in a meeting far in advance of any previous independent telephone convention, both in attendance and in the quality and character of exhibits. The advance over previous conventions is very marked in every way, and is a matter of common congratulation among those present at the meeting. The exhibits are unusually large, both in number and in the size of individual displays. Nearly two floors of the Auditorium Hotel are taken up by exhibitors.

A deep gloom was thrown over the convention early on the opening day through the sudden death of Mr. S. P. Sheerin, who was fatally stricken while addressing the convention in response to the address of City Prosecutor Taylor, who welcomed the convention to Chicago in the name of Mayor Dunne. As Mr. Sheerin took the floor he make some joking remarks apologizing for reading his response to the address of welcome. After a very appropriate and extemporaneous introduction to a typewritten response which he had commenced to read, he suddenly fell to the floor and expired within a few minutes. Although intense excitement prevailed, good order was maintained and the convention immediately adjourned and cleared the room. Mr. Sheerin had arrived in Chicago several days before the meeting in order to attend various committee meeting in connection with the telephone convention, and apparently had been in good health, though just previous to taking the floor he had remarked to Col. Powers that he was not feeling well. Mr. S. P. Sheerin, his son, was present at the meeting and took charge of the body, which was sent to Indianapolis the same evening.

The first session was called to order soon after 10 o'clock Tuesday morning by Col. J. P. Powers, of Louisville, who had been selected by the Executive Committee to act as chairman until a permanent organization should be effected. It will be recalled that this joint Executive Committee of ten members had charge of the plans for the organization of a new association through the consolidation of the National and Interstate Associations. Before any business was transacted the death of Mr. Sheerin occurred. At 3 P. M. there was a session of a few minutes, at which the chairman announced the selection of the following temporary officers: Secretary, A. L. Tetu, Nashville; assistants, Charles E. Wells, Kansas, and H. E. Bradley, Pennsylvania. After a few appropriate words by Chairman Taylor a committee of ten was appointed to draft resolutions expressing the great loss the association had met in the death of Mr. Sheerin. Other committees were appointed as follows: Committee of five on amendments to constitution, to consider any change that might be proposed; a committee of seven on credentials; a committee of five to meet the Telephone Manufacturers' Committee and to discuss relations. It was moved to carry out the business remainder of the programme, but to omit the banquet and entertainment features on account of the lamentable death of Mr. Sheerin.

At the opening of the session on Wednesday morning the report of the Committee on Resolutions on the death of Mr. Sheerin was presented. Temporary Chairman Powers then delivered an eloquent address, making a strong appeal for unity of action in resisting the efforts being made to break the strength of the independent telephone movement. The Committee on Nominations reported and its recommendation for the election of the following officers was adopted by vote: President, Mr. James B. Hoge, Cleveland, Ohio; first vice-president, Theodore Gary, Macon, Mo.; second vice-president, John Van Liew, California; secretary, A. L. Têtu, Nashville, Tenn.; treasurer, J. G. Splane, Pennsylvania. President Hoge then took the chair.

A committee was appointed to draft resolutions on the death of the late Judge James M. Thomas, founder of the Independent Telephone Association and for years its president. The Committee on Standard Forms for Accounting presented its report. Mr. W. L. Launbach read a paper on "Standard Toll Signs," in which he urged the adoption of a uniform sign or trademark for all independent telephone companies. The Committee on Advertising reported and recommended the adoption of the red, white and blue banner sign that has already been used by some State associations. This brought on a lengthy discussion on the merits of signs, some members favoring the Iowa and Michigan blue and white sign. The matter was referred back to the committee, with instructions to report later in the day. Mr. A. B. Green Shields then presented a paper on "The Value of Telephone Securities," which analyzed the finances of various classes of public service corporations and showed that independent telephone securities presented decided advantages to the investor. In the discussion that followed the paper was highly commended. The Committee on Standardization of Equipment recommended the establishment of a National Bureau to take cognizance of the details of such standardization.

At the opening of the afternoon session of Wednesday there was a rollcall of states and the delegate from each state was asked to present information showing the condition of independent telephony in his state and to give details concerning the state independent telephone organization, if one existed. California reported 20,000 independent telephones in Los Angeles, the population being 200,000, and 40,000 independent telephones in the state. The showing of Iowa proclaimed her to be the banner state, there being 220,000 telephones and a state organization in existence since 1896. Emphasis was placed on the strength which rural lines gave to the independent movement, this development being the secret of Iowa's success. Many incidents of the fight for territory between Bell and Independent companies were related during this rollcall. Invitations for the next convention were received from Atlantic City, Nashville, Detroit and Put-in-Bay, and were referred to the Executive Committee.

A paper by Mr. S. G. McMeen on "Combined Telephony and Telegraphy" was then read by title. An address on the programme by President Hoge, on "The National-Interstate Telephone Association," was also read by title, owing to lack of time. The Committee on Advertising again reported in favor of the red, white and blue sign, and after considerable further discussion its report was adopted. The convention then adjourned its sessions. Thursday was given up entirely to inspection of exhibits by the members in attendance.

The general feeling is that the new organization has before it a great prospect of usefulness, and fills at last a place in the telephone field that was never properly occupied by either of the component bodies, and that it will, above all, curtail the chances for mischief on the part of those who took advantage of the rivalry of the former organizations to bring into prominence narrow factional differences having little relation to the independent telephone movement as a whole. In other words, the new body promises to be a worthy companion to similar organizations representing other industries.

Convention of Canadian Electrical Association.

By Telegraph.

The Fifteenth Annual Convention of the Canadian Electrical Association was called to order Wednesday morning, June 21, and is without doubt the most successful ever held in the history of that body. Out of a total membership of 429, 270 are in attendance, representing every section of the Dominion. The weather is favorable and there is every prospect that all of the sessions will be well attended and that the discussions will be of the highest interest and value. The opening session was preceded by a meeting of the Executive Committee. The convention proper convened at 10:30 A. M., and after the reading of reports, a paper by Mr. A. Sammett was presented, entitled, "Effects of Frequency and Voltage on Transformers." At the afternoon session three papers were presented, namely, on "Transformers," by Mr. R. T. McKeen; "Selection and Maintenance of Service Meters," by Mr. William Bradshaw, and "Incandescent Lamps," by Mr. A. B. Lambe. For Thursday evening a smoker has been added to the programme as originally announced.

Tesla Split-Phase Patent Litigation.

An opinion has been rendered by the United States Circuit Court of Appeals for the Third Circuit (Western Pennsylvania) in a suit involving the Tesla split-phase patents, in which he Jefferson Light, Heat & Power Company was alleged to have infringed these patents in having used a meter involving the split-phase principle. The case had previously come before the court on an appeal from an order granting a preliminary injunction. This order of the lower court was reversed pending a plea that the case was *res adjudicata* in view of a decision rendered in the United States Circuit Court of Appeals sitting in New York in the case of the Catskill Illuminating & Power Company, the decision of this court being that the Tesla split-phase patents were invalid through anticipation. Subsequently the present cause proceeded to a hearing, resulting in a decree overruling the bill of *res adjudicata*, declaring infringement and granting an injunction. From that decree the defendant appealed on the ground that inasmuch as the Catskill case was defended by the Diamond Meter Company, and the present case is defended by the same company, the Catskill case was *res adjudicata* of everything involved in the present case. The opinion was written by Judge Acheson, and the court held that the Diamond Meter Company did not avowedly or openly conduct the defense in the Catskill case, and having concealed its connection with the case while it was pending, it is now too late for it to set up the decree in that case as an estoppal against the complainant in the present case. The plea was overruled and the granting of a preliminary injunction by the court below affirmed.

The United States Circuit Court of Appeals for the First District in a suit involving also the Tesla split-phase patents, in which the Stanley Instrument Company was the defendant, has denied a petition of the latter to file a supplementary bill in the nature of a bill of review, or to amend the judgment on appeal. In this case the lower court decided against the split-phase patents and was reversed on appeal. Application was then made to the Supreme Court for a writ of certiorari on the grounds of conflict with the action of the Catskill case, which was denied. The petition of the present cause was based on the grounds that certain English Tesla patents on identically the same subject matter as the patents in suit expired in 1903, and that this expiration was a complete defense as against the patents in suit. The court held that since the foreign patents expired only a few days after the decree was entered in the lower court and before the appeal was heard, the question of laches on the part of the petitioner could not be wholly overlooked. The court held, however, that the merits of the case with respect to the identity of the foriegn and American patents are so clearly against the petitioner that it was not necessary to pronounce on the question of laches. In order that the term of a foreign patent may be limited by a domestic patent, it is essential that the inventions covered by the two patents should be identical. This is not true with respect to the patent cited in this suit. While it is true that one claim of the British patent neces-

sarily includes all the elements of the American patents, it also includes other elements establishing a new combination which is an essential, novel and patentable improvement on what was claimed in the patents before the court on appeal. This claim covers not only the mere improvement on either split-phase invention or polyphase invention separately, but it covers an invention by which a convertable motor is produced. This necessarily takes the case out of the field of identity with either the earlier polyphase or the later split-phase patents. The petition was denied.

A. I. E. E. Presidential Address.

For his address at Asheville, President Lieb took as a subject "The Organization and Administration of National Engineering Societies." The rise of such societies, dating in Great Britain from 1828, when Thomas Telford and others founded the Institution of Civil Engineers, was sketched.

After quoting the sections of the constitutions of the four bodies which specify the requirements for membership in the several grades, Mr. Lieb pointed out that two of the societies fix an age limit of thirty years, one twenty-seven years and one fixes no limit; one requires professional practice of ten years, one five years, two no time specified; three require professional competency in designing as well as constructing or directing engineering works; one requires the applicant to be professionally or practically engaged in the branch.

In the case of the Mechanical Engineers and the Civil Engineers the election is by ballot of the membership at large after approval by the Executive Board or Council; in the case of the Mining Engineers and Electrical Engineers, election is by direct vote of the Board of Directors, in the latter after submitting the names to the membership at large, in the former without submission. In the Mining Engineers, Mechanical Engineers and Electrical Engineers the application is first passed upon by a Board of Examiners and then by the Executive Board or Council; in the case of the Civil Engineers by the Board of Directors directly without action by an Examining Board. The Electrical Engineers' constitution requires that all members be first elected as associates and then transferred by the board. It would appear at first thought that the more explicit the constitution in its exact definition of the conditions for membership the easier it would be for the Membership Committee to act, but this is by no means always the case, as it often prevents the taking of a broad view of the candidate's eligibility and is apt to exclude desirable material on very technical grounds, although on the other hand it is a protection against loose interpretation of the requirements by careless examiners. Mr. Lieb suggested that there might be a better division of responsibility and more direct control of the class of men admitted to membership by giving wide publicity to their candidacy and election by ballot by the membership at large, after the candidates have passed the scrutiny of the Board or an Examining Committee. A young society covering a branch of engineering that has but recently become specialized cannot in the beginning impose rigorous requirements as to age limits or time of professional service and the branch of engineering may be such as to make it difficult to impose severe technical requirements.

In the case of the Civil Engineers the accepted definition is sufficiently broad to cover applicants who are professionally engaged in any of the other branches of engineering; the Mechanical Engineers' definition is somewhat less comprehensive, the Mining Engineers' still less so, and the Electrical Engineers' really restrictive to professional electrical engineers. Under the constitution of the latter, however eminent a man may be as a civil, mechanical or mining engineer, he may not fulfil the qualifications of an electrical engineer. It is very difficult for an applicant in every respect qualified for full membership in the Institute to understand why it should be necessary for him to pass through the preliminary, or as it were, probationary grade of associate, and then be transferred to full membership, but the constitution is clear. Applicants whose superior qualifications would entitle them to immediate election to full membership after their election to the preliminary grade of associate, which takes some time—several months at least—are apt to fail to make application for transfer, with the result that many remain in the associate grade who should certainly be transferred and when they find the cause of the delay are apt to criticise the administration.

As to the grades of membership, associate membership, associates, juniors, etc., it is necessary to provide one or more grades for young men just entering professional life, and through which they can rise as they acquire experience to the dignity of full membership; but it is necessary to provide also for another class of men who, while they are not professional engineers, yet co-operate with them and conduct engineering works, acting as the executive heads or business managers. To such men eminent in their particular branch of activity, it is humiliating to be placed permanently in an inferior grade of membership with the beginners in professional service and the situation can be satisfactorily met by the establishment of the grades of associate, junior and associate membership, these to represent successive steps in the advancement to full membership, the associates forming a class by themselves.

Taking up the subject of dues, a table is given showing a considerable diversity. The entrance fees of the Civils are $10 for juniors, $20-$25 for associates and $30 for members. The Minings have only one entrance fee—$10. The fee in the Mechanicals is $15 for juniors and $25 for associates and members, and $5 for associates and $15 for members in the Electricals. President Lieb suggested that the entrance fees of the Institute be increased to $10 for associates and a fee of $15 at transfer to full membership, and that the yearly dues of members residing within 50 miles of New York be increased to $15 for associates and $25 for members.

The following table was given of receipts and disbursements per year per member in the several societies:

	Civil.	Mining.	Mechanical.	Electrical.
RECEIPTS:				
Entranec fees	$2.59	$.28	$2.45	$.83
Dues	16.99	10.65	14.04	9.30
Transactions, sales and adv.	1.86	2.09	1.64	1.70
Badges and certificates	.65	..	..	.28
Interest	.36	.34	..	.21
	$22.45	$13.35	$18.13	$12.32
DISBURSEMENTS:				
Transactions	$4.63	$5.28	$7.50	$3.77
Salaries, etc.	6.13	4.22	3.99	2.20
Meeting expenses	.29	.30	.94	.82
Library, includ. rent. and salaries	.30	.80	.39	.81
Rent	2.84	.74	2.79	.75
Stationery and miscell. printing	.62	.34	1.19	.70
Postage	1.10	1.02	.26	.66
General expenses	.34	.47	.11	.54
Badges and certificates	.50	..	.33	.25
Express	..	.83	..	.22
Totals	$16.75	$14.90	$17.50	$10.72
Credit balance per member	$5.70	$.65 (Deficit.)	$.63	$1.60

Taking up next the method of nomination and election of officers, President Lieb said that a truly national society should draw its membership from all parts of the country and should afford representation in its officers and on its administrative committees to the membership at large; in other words, should select its officers as far as possible with a view also to geographical distribution. It is admitted that this is difficult owing to the opportunities afforded to practicing engineers by large enterprises whose administration, technical as well as financial, is located in the important commercial centers, hence the important groups of members in the large cities. From these are drawn the majority of the officers, such selection being emphasized by the necessities of the central administration of the society. Such tendencies, however, are apt to operate to the disadvantage of available candidates for the important posts of honor within the gift of the societies who may happen to be stationed some distance away from headquarters and to keep the institution on the plane of national standing it should also have a care to broad geographical distribution. This end can best be accomplished by providing for a nominating committee selected according to a geographical distribution into approximately equal groups of members, each geographical district consisting of, say, 300 or 400 members, and upon these, in consultation with a number of past officers, would rest the selection of the official nominees, with provision also for the filing of such nominations as may be made directly by the general membership. This procedure was introduced by the American Society of Civil Engineers several years ago. Such a plan would provide geographical representation and at the same time discourage unseemly electioneering and circularizing for the coveted posts of honor. It is thought by some that the Institute could with advantage modify its own procedure in this direction.

The election once accomplished the officers-elect could again with advantage to the interests of the Institute take office at once at the close of the annual meeting, or at latest as the last act of the annual convention. The supercession of the retiring president and officers and the installation of the new should be an official function before a general Institute meeting, a deficiency of our present method of procedure, which now allows four months to elapse after the election of the new officers before they actually take office, and within

three months or at most four months after taking office the active canvass for their successors already begins. It will be admitted by all with experience in the administration of professional societies that it is most desirable to eliminate alll tendencies to political agitation in connection with the election to the honors within the gift of the membership, concentrating all efforts on the advancement of the professional standing of the society and the interests of its members. It would also seem to be of advantage to have the fiscal year coincident with the calendar year; this would bring the annual meeting less close to the annual convention, and spreading it over several days would secure a larger attendance of the out-of-town membership for the annual business meeting and the annual banquet or other functions could be held at this time. The annual meeting as held at present is not markedly distinguished from the other monthly meetings, and there is usually only a month between it and the annual convention. With the growing importance of the financial interests confided to the care of the successive administrations the yearly business meeting should have larger attention and participation from the membership at large than is the case at present.

The administration of the societies should be in the hands of their Board of Directors or Councils, and similarly the important standing committees in whose hands rest the conduct of the routine in the several branches of administration should be the committees of the Board or Council. Such being the case it is desirable that their appointment should in the beginning rest with the Board itself, one member of each standing committee retiring each year and the new President filling the vacancies, a much more satisfactory arrangement than the plan followed by our Institute at present, under which the responsibility of the appointment of all the committees, standing as well as special or temporary, rests alone with the President. The suggested plan of appointment of the administration committees primarily by the Board or Council, the President filling the vacancies that occur each year, is not the one usually followed by our national societies, but even where all the appointments devolve on the President alone, membership on the standing committees is as a rule limited to members of the Board. The advantage of selecting the standing committees from the members on the Board is evident, as the committees are then not apt to follow a policy at variance with the wishes of the executive body, disturbing harmonious relations and continually raising question of jurisdiction.

It is also desirable to avoid constant changes in the personnel of such important committees as the Finance, Library and Membership committees; provision should be made for standing committees of three or five with one member retiring each year, the new members to be appointed by the incoming President. Such a plan secures continuity of policy, gives the committees the benefit of accumulated experience and relieves the President of the responsibility of making such a large number of new appointments on entering his term of office. Such standing committees as Finance, Membership, Library, Publication and Meetings, or the last two consolidated into one, are necessary for all societies, together with such other committees as the particular field covered by the work of the society may require. Outside of the standing committees required by the regular routine, it is desirable to avoid as far as practicable the appointment of special or temporary committees, and these when the special work assigned to them has been performed should be discharged. There is nothing more subversive of effective and energetic administration than Board meetings at which an interminable series of committees make "no report" or the chronic "report of progress."

In case it is considered advisable to appoint a separate "Committee on Meetings" or "Papers and Meetings" and a "Committee on Publications" or "Editing Committee"—a division of work which becomes necessary when monthly meetings are held with reading of papers and discussions as well as one or more annual meetings —it becomes necessary to define their respective responsibilities very clearly, placing upon the Committee on Meetings or Papers the responsibility of the acceptance of the paper or communication for presentation at the meeting and upon the Publication or Editing Committee alone the responsibility for the publication of the paper or discussion, as a whole or in part, in the official transactions of the society.

It might be observed here that great care should be exercised in the conduct of a society occupied with a specific branch of engineering, that as far as practicable all of its divisions receive due consideration. In an Institute of Electrical Engineering, Telegraph and Telephone, Electric Traction and Electric Lighting, Central Station and Isolated Plant, Transmission and Distribution, Design and Construction, Theory and Practice, in fact all branches of Electrical Engineering, should receive consideration and in the solicitation of papers for the series of meetings held during the year a wide range of subjects should be covered so as to interest and attract the largest circle of members.

The members at large should have a share in the benefits as well as the obligations of membership whether they be located near the headquarters of the society or at a distance. It is manifest that when the monthly meetings, as well as the more important annual functions, are held at the headquarters of the society, the members at a distance feel that they are at a disadvantage, and there is a tendency to form local clubs or organizations and secede from the parent society or at least lose interest in it. The Institute has met this situation courageously, and through the initiative of Past President Scott a series of local organizations was established and they have been added to under succeeding administrations; these organizations have done much to keep up the interest at distant points and they have undoubtedly induced desirable accessions to the membership and have been an important stimulant of professional activity.

Sister societies are facing the same problem and are watching the result of our undertaking—it can no longer be called an experiment—with great interest. But this scheme of local organizations while undoubtedly successful, is developing new problems and new conditions and requires the constant care and supervision of the central administration.

The Ganz Traction System in America.

We are in receipt of the following official announcement as to the revival of the Ganz projects in the United States:

The Ganz system of three-phase, alternating-current electric traction, which is well known in Europe, is to be introduced on this side. This system, for which much is claimed in the way of cheaper initial cost and operation over the existing electric railway construction methods at present in vogue in this country, is to be exploited by the Railway Electric Power Company, in which several New York capitalists and railroad men are primarily interested. The company has acquired the electric traction patents and manufacturing rights of Ganz & Co., of Budapest. These rights, etc., cover the United States, Mexico, Cuba and all the West Indies other than those under British supremacy. The board of directors of the company is composed of John E. Borne, president of the Colonial Trust Company; William L. Bull, of Edward Sweet & Co.; Henry Seligman, of J. & W. Seligman & Co.; Stephen Peabody; H. R. Duval, of the Atchison, Topeka & Santa Fe Railroad; Leopold Wallach, of Wallach & Cook; Henry L. Sprague, of Stetson, Jennings & Russell; Gustav Lindenthal, former Commissioner of Bridges, and Gustave Leve.

L. B. Stillwell, electrical director of the Interborough Rapid Transit Company, and Frank N. Waterman are the consulting electrical engineers.

Director Leve says: "The huge initial cost of converting steam railroads, on this side of the Atlantic, has been a veritable stumbling block to the various managements considering change of motive power. The installation of the three-phase system costs about 40 per cent. less than that of direct current, which is the prevailing mode of electric traction so far installed by the large American electrical companies. Another important claim made for the three-phase system is that it is the only method which provides for recuperation of power on down grades. In other words the power usually wasted in braking and in coasting down grades is by this system returned to the line as useful energy for handling other trains. It furthermore saves the wear and tear in rails, brake-shoes, wheel-tires, caused by mechanical braking. The most striking illustration of the three-phase system is the 65-mile Valtellina line of the Italian State Railway, which has been inspected by electrical engineering experts from all over the world. The operating cost has been reduced by upwards of 50 per cent. over steam locomotive operation, which was formerly the power used. The Ganz people have lately perfected the three-phase system so that if necessary three-phase equipment can be run over lines already installed with direct or single-phase current. Negotiations are already under way with one of the big trunk lines looking toward the conversion of part of its road into electric motive power."

Tesla on Subway Dangers.

The New York *Sun* of June 16 printed the following letter from Mr. Nikola Tesla:

The flooding of the subway is a calamity apt to repeat itself. As your readers will remember, it did not occur for the first time last Sunday. Water, like fire, will break loose occasionally in spite of precautions. It will never be possible to guard against a casual bursting of a main; for while the conduits can be safely relied upon under normal working conditions, any accidental obstruction to the flow may cause a pressure which no pipe or joint can withstand.

In fact, if we are to place faith in the gloomy forecasts of Commissioner Oakley, who ought to know, such floods may be expected to happen frequently in the future. In view of this it seems timely to call to public attention a danger inherent to the electrical equipment which has been thrust upon the Interborough Company by incompetent advisers.

The subway is bound to be successful, and would be so if the cars were drawn by mules, for it is the ideal means of transportation in crowded cities. But the full measure of success of which it is capable will be attained only when the financiers shall say to the electric companies: "Give us the best, regardless of expense."

It is to be regretted that this important pioneering enterprise, in other respects ably managed and engineered, should have been treated with such gross neglect in its most vital feature. No opportunity was given to myself, the inventor and patentee of the system adopted in the subway and the elevated roads, for offering some useful suggestion, nor was a single electrician or engineer of the General Electric and Westinghouse companies consulted, the very men who should have been thought of first of all.

Once large sums of money are invested in a defective scheme it is difficult to make a change, however desirable it may be. The movement of new capital is largely determined by previous investment. Even the new roads now planned are likely to be equipped with the same claptrap devices, and so the evil will grow. "Das eben ist der Fluch der boesen Thut, das sie fortzeugend Boeses muss gebaeren."

The danger to which I refer lies in the possibility of generating an explosive mixture by electrolytic decomposition and thermic dissociation of the water through the direct currents used in the operation of the cars. Such a process might go on for hours and days without being noticed; and with currents of this kind it is scarcely practicable to avoid it altogether.

It will be recalled that an expert found the percentage of free oxygen in the subway appreciably above that which might reasonably have been expected in such a more or less stagnated channel. I have never doubted the correctness of that analysis and have assumed that oxygen is being continuously set free by stray currents passing through the moist ground. The total amperage of the normal working current in the tunnel is very great, and in case of flooding would be sufficient to generate not far from 100 cubic feet of hydrogen per minute. Inasmuch, however, as in railway operation the fuses must be set hard, in order to avoid frequent interruption of the service by their blowing out, in such an emergency the current would be of much greater volume and hydrogen would be more abundantly liberated.

It is a peculiar property of this gas that it is capable of exploding when mixed with a comparatively large volume of air, and any engineer can convince himself by a simple calculation that, say, 100,000 cubic feet of explosive might be formed before the danger is discovered, reported and preventive measures taken. What the effect of such an explosion might be on life and property is not pleasant to contemplate. True, such a disaster is not probable, but the present electrical equipment makes it possible, and this possibility should be, by all means, removed.

The oppressiveness of the tunnel atmosphere is in a large measure due to the heat supplied by the currents, and to the production of nitrous acid in the arcs, which is enhanced by rarefaction of the air through rapid motion. Some provision for ventilation is imperative. But ventilation will not do away with the danger I have pointed out. It can be completely avoided only by discarding the direct current.

I should say that the city authorities, for this if for no other reason, should forbid its use by a proper act of legislation. Meanwhile, the owners of adjacent property should object to its employment, and the insurance companies should refuse the grant of policies on such property except on terms which it may please them to make.

New York Electrical Society.

The New York Electrical Society held its twenty-fourth annual meeting at the Café Boulevard on the 14th inst. The meeting was preceded by a dinner to which 80 members and their friends sat down. In the absence of President F. J. Sprague in Europe, Vice-President F. C. Bates, in a short speech, touched on some of the special features of this season's work of the society, and referred to the evidences of the wider representation which the society is now securing. Mr. Bates noted as of pleasing significance the fact that one of the tables, containing over 20 guests, was occupied almost entirely by telephone men. Furthermore, members of nearly every branch of electrical industry were to be found in the company present. There was, however, one most important section, that of street railway work, which ought to be more fully represented in the membership of the society, and it was gratifying to believe that in this direction the placing of Mr. H. G. Stott on the nomination list was a happy augury. The finances and the membership list of the society were in sound and vigorous condition, and there were even now signs that the coming year will be the most successful in the history of the society. More than half of an exceptionally fine series of lectures had already been arranged for, and the organization of plans for an active compaign in the adding of new members was well on the way. Mr. Bates concluded by congratulating the society, not only on its gratifying present, but also on its possibilities in the near future.

The secretary's report showed that 46 members had been elected during the season; the loss by death had been 4, by resignation 25; 10 had been dropped, and the total existing membership was 636. The report of the treasurer showed a steady improvement in the finances of the society. The officers elected were: President, Mr. W. S. Barstow; vice-presidents, Messrs. H. G. Stott, Putnam A. Bates, Max Loewenthal. (The vice-presidents elected in 1904 for two years are Messrs. Albert F. Ganz, Louis B. Marks, W. S. Rugg.) Secretary, Mr. George H. Guy; treasurer, Mr. H. A. Sinclair.

An excellent musical programme was admirably supplemented by the artistic singing of Mr. Charles Stuart Phillips.

Single-Phase Railroad from Vienna to Baden.

The Austrian Siemens-Schuckert Works in Vienna are about to install the single-phase system on the Vienna-Baden line of the "Vienna Local Railroad." This line is at present operated partly with steam and partly with direct current. It is mostly double track with standard gauge, and has a total length of about 17 miles, the steepest grade being 2.75 per cent. and the smallest radius of curvatures 54 ft. The trains run into the centres of the two cities, using the rails of the city tramway systems. Within the two cities for a length of line at about 2½ and 1¼ miles respectively direct current is used at 500 to 550 volts.

For the line between the two cities, which is about 13 miles long, single-phase current at 500 volts is to be used. The power plant, which is at a distance of about 1¼ miles from Baden, contains two single-phase alternators, each of 200 kilovolt-amperes, at 100,000 volts, a direct-current machine of 165 kilowatts at 550 volts, and two fly-wheel motor-generators, consisting each of a 150 kilovolt-ampere, 10,000-volt synchronous motor, a 100-kw, direct-current machine and a fly-wheel weighing 11 tons. There is also installed a storage battery. The voltage of the alternating current is lowered from 10,000 to 500 in six transformer stations placed along the line, each containing an oil-cooled, 110-kilo-volt-ampere transformer.

Each motor car has two four-wheel trucks and carries four series single-phase motors of a type made by the Siemens-Schuckert Works, and rated at 50 hp. There are provided series connection and shunt connection with resistance regulation, for use as well on the direct current as on the alternating current portions of the road. For the alternating current portion there is also provided a transformer with six voltage ranges, three being used for raising and three for

lowering the voltage at the motors, for the sake of speed regulation.

The maximum speed is intended to be 36 miles per hour. For the present 13 motor cars, each of 18½ tons, and 18 trailers, each of 10 tons, are to be installed. At rush hours the trains will follow each other at intervals of 15 minutes, express trains from one city to the other city and local trains being run. The speed of the express trains will be for the present 21 miles per hour, and the speed of the local trains 15½ miles per hour. For the summer season there will be run 21 express trains and 17 local trains on week days and 45 express trains and 16 local trains on Sundays. The number of trains to be run per year will be 13,400 express trains (6,152,000 ton miles) and 12,000 local trains (5,224,000 ton miles). The line is to be opened in the summer of 1906.

Death of S. P. Sheerin.

The telegraphic report which we print elsewhere gives details concerning the death of Mr. Simon P. Sheerin, at Chicago, on Tuesday, June 20, while responding to an address welcoming the National-Interstate Telephone Association at the opening of its convention. Mr. S. P. Sheerin was born in Dublin, Ireland, February 14, 1846. His father, a manufacturer and an Irish revolutionist, came to the United States in 1849, landing at New Orleans. Later the family located at Dayton, Ohio, where Mr. Sheerin received his early education in the public schools, supplemented by a course in a commercial college. He then learned a trade, and in 1866 moved to Logansport, Ind. In 1875 he became the editor and part proprietor of the Logansport *Pharos*, one of the important Democratic papers of the State. He was a member of the State Democratic Executive Committee in 1884, 1886 and 1888. In the latter year he was elected at the National Democratic Convention held at St. Louis a member of the National Democratic Committee, of which committee he was the same year made secretary. He was re-elected as secretary in 1892, and was secretary of the National Democratic Convention in 1898. During recent years Mr. Sheerin had been identified with many large enterprises, notably those connected with natural gas and telephony, and was president of the Indianapolis Long-Distance Telephone Company. He was warmly interested in the independent telephone movement, and one of the most active spirits in the Independent Telephone Association of America. For several years he was secretary and treasurer of this body, and always took a prominent part on the floor at its meetings. At the Chicago convention in 1899 he contributed a paper on "Long-Distance Toll Lines," and at the Buffalo meeting in 1901 a paper on "Village and Farmers' Telephones."

Course in Electric Transportation at Brooklyn Polytechnic.

The Brooklyn Polytechnic Institute has announced an evening course of instruction in electric transportation under Prof Samuel Sheldon, head of the Department of Physics and Engineering. The course will commence October 10 and extend to April 24. It will include a series of lectures by leading electrical engineers identified with the electric traction industry, and a series of laboratory tests.

Mr. C. O. Mailloux will deliver 15 two-hour lectures on electric train movement, treating of the subject from the physical, mathematical and engineering standpoints. Prof. Samuel Sheldon will deliver 15 two-hour lectures on alternating currents, illustrated by occasional experiments, and 15 two-hour lectures on mechanics and heat. Under Prof. Sydney Ashe there will be 20 two-hour laboratory tests on alternating-current generators and motors. Lectures will also be delivered by Messrs. H. A. Lardner, A. H. Armstrong, W. S. Barstow, H. G. Stott, W. L. Bliss, J. S. Doyle, John F. Calderwood, Dr. F. A. C. Perrine and R. Burnham Moffat, Esq., of the New York bar, on the following subjects, each lecture extending over two hours:

Armstrong: Influence of Traffic Conditions on Motor Specifications; How to Select the Proper Motor Equipment; How to Design the Substations and Low Potential Distributing System; How and Where to Substitute Electricity for Steam. Stott: How to Design the Power House; How to Organize the Operating Force of the Power House; How to Purchase Fuel. Lardner: How to Route the Line and Determine the Most Suitable Service. Barstow: Where to Locate the Power House. Perrine: How to Develop a Water Power. Bliss: How to Light Ordinary Pullman Cars by Electricity. Doyle: Maintenance of Electrical Equipment and Rolling Stock. Calderwood: How to Operate the Complete Plant. Moffat: Legal Points as to Franchises, Organization, Eminent Domain and Liability.

Central Station Buildings.

The "Question Box" of the National Electric Light Association for the present year opens with queries and answers relating to central station buildings. In reply to a query as to whether it pays to build brick or stone substations for mines and smelters, all the replies, five in number, recommend brick, stone or concrete buildings. One answer advocates concrete as more enduring and solid than brick or stone. In reply to a question as to the best floor construction for different types of central stations, the answers, eight in number, are unanimous in favor of concrete floors, some adding the recommendation of a finish of encaustic tile or cement. The construction of concrete floor arches supported on steel floor beams or of reinforced concrete are recommended.

Seven answers are given to a question asking recommendations as to the most desirable roof construction for a brick engine room. Two of the answers recommend "book tile" supported by a steel structure; one simply advises that the top of the tiles be plastered with cement or mortar or covered with a thin layer of concrete, and the other specifies the addition of five thicknesses of tarred paper laid on with hot tar and finished with building gravel, the under side of the tile being plastered, and painted also, if desired. Other recommendations are a roof of asbestos lumber shield; a slag roof on five-ply felt over 3 in. Southern yellow pine supported by 3 in. x 12 in. Southern yellow pine purlins; a steel construction with cinder concrete and expanded metal, exposed metal being covered with asbestos and the top of the roof painted with water-proof paint; a reworked corrugated-iron roof with an air space of 2 in. under the iron, then a layer of heavy roofing paper supported by 2 in. mesh galvanized wire netting; a high grade composition roof, such as the Carey roof. In one answer it is stated that slate roofing will meet all the requirements of the inquiry. Another inquiry relates to a flat roof with only sufficient pitch to allow water to run off. Of five recommendations for this case, three are for a tar and gravel roof, a fourth for a slag roof and the fifth for a composition roof. As to the best fireproof and non-corroding covering for boiler rooms, one reply recommends concrete and cement; another a high-grade composition and the third a corrugated roof with a 2-in. air space above a layer of heavy roofing paper supported by galvanized iron netting.

Considerable difference of opinion appeared in replies to a question as to why a tin roof pits and rusts through near a hot water storage tank on the roof, the rest of the roof remaining good. One reason given is that the rusting is due to the sweating between the roof boards and tin, and it is recommended to raise the tank so that the air may circulate between the roof and the bottom of the tank; another is that the tank prevents the sun from warming the tin and drying it off on the under side; one of the answers ascribes rusting as due to sulphuric acid and coal dust; another to chemical action stated to be set up by hot water; and still another to the water of condensation on the surface of the tin absorbing sulphur from the surrounding atmosphere, thereby making dilute sulphuric acid, which readily finds its way through the thin coating of tin to the steel plate. A remedy suggested is the use of pure iron tin plates. A question as to whether the use of hand power cranes in rotary converter or motor generator substations justifies the expenditure for extra strength and height of walls received five replies. Two of these considered such an expenditure justified; another limits the use of hand cranes to stations of 1,000 kw or larger, and still another gives 400 to 500 as the power limit. In one answer it is stated that substation machines are now being built in such a way that ordinary repairs can readily be made without the use of a crane. The Edison Illuminating Company of Detroit expresses the opinion that some equivalent for a crane is much more frequently needed in a station filled with small units than one equipped with a few large units. Its plan is to install a track and supports for a crane in each station, all having the same span, and the use of a single crane for a number of substations.

In reply to a query as to a battery room floor material other than vitrified brick or tile, one answer recommends asphalt on a concrete foundation as giving a satisfactory floor surface; another recommends a properly graded concrete floor with a finished cement surface; another states that vitrified brick and tile are the most satisfactory materials for a battery room under general conditions, but in the case of a small battery room, such as that for an exciter battery, where there is not much excuse for getting acid on the floor, concrete with a granolithic finish makes a good floor.

Politics and Electricity.

Apparently following the example of the preachers who create sensations by giving object lessons in card-playing from the pulpit, a candidate for political office in Pennsylvania has adopted the plan of illustrating political principles by performing on the stump electrical "experiments." The gentleman is a candidate for State Treasurer, and we clip the following account of his electrical "faking" from the Philadelphia *Record*:

"Mayor Berry himself illustrated his speech in a manner unique on the hustings—and quite convincing. He used electricity, which he characterized as an element in some degree typifying God's eternal justice and truth as applied to the other forces which a kind Creator had placed in the hands of man for use, not abuse.

"He then took a substance out of a box, and, holding it up, he referred to it as a polarized piece of wire—the type of a citizen with an idea—the electric idea looking for the eternal truth and justice of God. Bending the wire into coils, he explained how this multiplied the force of the electric current, even as a man by labor and effort increased and widened the scope and influence of his idea. At that time such a man was usually called a crank.

"Taking two more pieces of wire, he bent them into horseshoe shapes and coils, and showed how this vastly increased the potentiality of the electrical current. 'You now have the power and the potentiality of American politics—live wires and live men,' said he, 'and the closer they are bent together and the more numerous, the stronger they become.'

"Next taking a little coil of wire, he showed how the current, strong though it was, was uncertain, and a great deal of it leaked, and it lacked effectiveness. Taking a rod of lead, he thrust it through the concentric circles of the coil and showed how this made the loose coils so powerful that two horses could not drag the metals apart. 'And there you have, at their best, the great political parties!' he said.

"Next he bent the rod into a half circle, which intensified its strength fourfold, and said: 'There you have the great organizations, which lead tc mighty results, under upright and competent leadership.'

"Then Mr. Berry, with a twist of his hand, brought the ends together, and said: 'Now you have the ring, the ring in politics; the ends are closed; the electric currents run in circles. Loosen its energy and its virtue stands for naught that is good, even as a ring. The ring in the Republican party to-day stands for a depolarized political situation, valueless and negative, save for evil.'"

The account concludes with the statement that when Mayor Berry was through with his illustrations the audience cheered him to the echo.

Electrical Show in Boston.

At a recent meeting of the Executive Committee of the Massachusetts Association of Electrical Contractors, the Chairman, John P. Coghlin, reported that Governor Douglas, Mayor Collins and a number of prominent insurance, engineering and railroad officials will be the guests of the Association on Wednesday, July 19, at the fifth Annual Convention of the National Association in Mechanics Hall, in connection with the big electrical exposition which opens on July 15. On Wednesday evening the annual banquet of the Association will occur.

The Secretary, A. T. Sampson, reported that delegates from thirty-nine States have already arranged to attend; also that Reeves' American Band has been engaged for the week of the exposition, with a number of soloists, who are all favorites in New England. The decorations, he said, will be on a scale of grandeur never before attempted, and the matter of a public pageant is in the hands of an efficient sub-committee.

At the annual meeting of the Massachusetts Contractors' Association the following officers were elected: President, Frank L. Barnes, Boston, Mass.; first vice-president, John P. Coghlin, Worcester, Mass.; second vice-president, W. B. Edgar, Fall River, Mass.; secretary, Henry D. Temple, Worcester, Mass.; treasurer, H. S. Potter, Boston, Mass.; director to National Association, S. B. Wetherbee, Boston, Mass.

The N. E. L. A. Question Box.

The printed report made to the Denver Convention of the National Electric Light Association by Mr. Homer E. Niesz, editor of the "Question Box," consists of a large octavo volume of no less than 595 pages, and containing probably more than 2,000 answers to queries submitted by members of the association to the editor. Reference to the vast fund of information contained in these answers is rendered easy by several indexes. One of these gives the headings, numbering 26, under which the queries and answers are classified. This index is expanded into one following, which contains entries of all the questions asked and answered under each of the heads, with page references. This is followed by a still further expanded general index of subjects, and a final index gives the names of contributors, with references to their answers to questions.

The section on meters occupies the most space, taking up 62 pages. This is closely followed by the section on overhead lines, comprising 58 pages. Next in amount of space occupied and exceeding 20 pages each, come contracts and rates, 36 pages; lamps, 31 pages; switchboards, instruments and station wiring, 28 pages; boilers and mechanical stokers, 28 pages; generators and exciters, 25 pages; engines, 22 pages; and transformers, 21 pages. Other subjects covered are as follows, the numeral following giving the number of pages: Feed-water, heaters and pumps, 19; heating, battery charging and power, 18; piping condensers, etc., 17; fuel, 14; underground lines, 14; district heating, 16; waterwheels, water power, etc., 11; storage batteries and boosters, 14; accounting and statistics, 10; management, 11; advertising, 8; buildings, 7; forced draft, blowers, stacks, etc., 7; turbines, 6; belts and shafting, 4; oil and waste, 4; miscellaneous, 14.

Owing to the answers being condensed in most cases to a minimum of words, the amount of information contained in the present issue of the "Question Box" is even greater than indicated by the increased number of pages over previous issues. The value of this publication to central station men is inestimable and to any intelligent man should far exceed the amount of the association membership fee. The amount of work entailed in the correspondence incident to getting together the matter and editing the same for publication when received, has undoubtedly been immense, and the association owes a deep debt of gratitude to the editor for his labors.

From time to time we shall print under various heads, collations of the answers to queries.

Dalrymple on Municipal Ownership.

M. J. Dalrymple, of the Glasgow municipal tramway system, who came over to advise the city authorities of Chicago as to the municipalization of trolley lines there, is quoted as follows, in an interview in Philadelphia: "To put street railroads, gas works, telephone companies, etc., under municipal ownership." he said this evening, "would be to create a political machine in every large city that would be simply impregnable. These political machines are already strong enough with their control of policemen, firemen and other officeholders.

"If, in addition to this they could control the thousands of men employed in the great public utility corporations, the political machines would have a power that could not be overthrown. I came to this country a believer in public ownership. What I have seen here, and I have studied the situation carefully, makes me realize that private ownership under proper conditions is far better for the citizens of American cities."

Mr. Dalrymple has sailed from Boston for home by the Cunard liner "Saxonia," and expects to prepare and file his report to Mayor Dunne, of Chicago, on the voyage.

Canadian Electrical Association.

The Canadian Electrical Association at its meeting this week at Montreal, considered a programme consisting of nine papers, mostly of a practical character, giving résumés useful to the central station man who does not get an opportunity to follow closely the latest advances. Instead of holding a regular session on Thursday afternoon, visits were made to the Allis-Chalmers-Bullock factory at Rockfield, and to electric sub-stations and other places of electrical interest in Montreal. Following is a list of the papers presented:

"Effects of Frequency and Voltage on Transformers," by Mr. M. A. Sammett; "Transformers," by Mr. R. T. McKeen; "Selection and Maintenance of Service Meters," by Mr. William Bradshaw; "Incandescent Lamps," by Mr. A. B. Lambe; "The Operation of Alternators in Parallel," by Mr. A. L. Mudge; "Induction Motors," by Mr. H. A. Burson; "Heating of Enclosed Inductors," by Prof. R. B. Owens; "Economy of Isolated Plants," by Mr. K. L. Atkin; "Notes on Steam Engines and Boilers," by Mr. William McKay.

The paper by Mr. Sammett considered the subject of operation of transformers at various frequencies and voltages under the heads of hysteresis loss, eddy current loss, core loss, characteristics at variable voltages, exciting current and regulation. After examining into the various factors affecting hysteresis, the conclusion is arrived at that a decrease in frequency results in an increase in hysteresis and consequently in a higher temperature of the transformer iron. A table is calculated from formulas developed in the paper, which shows that with a hysteresis loss taken at unity, at a frequency of 133 cycles, the loss at a frequency of 25 cycles is 2.726. It is also shown that the exciting current varies as the 1.6 power of magnetic induction, which in turn varies inversely as the frequency. It therefore follows that a lowering in frequency increases the exciting current, thereby decreasing the no-load efficiency of the transformer as well as that of the entire plant. As to regulation, this is affected but slightly by frequency; a lower frequency gives better regulation, but with 50 per cent variation of frequency the difference will not exceed 0.1 per cent. Calculations are given showing that the capacity of a transformer greatly decreases when the voltage varies from the normal. The conclusions of the paper are that a higher voltage amounting to 10 or 20 per cent will not affect the loss materially except that the increased core loss will reduce the all-day efficiency of the transformers. This difference in the case of a 10 per cent rise will amount to .8 per cent, and a 20 per cent rise higher losses will result in abnormal heating on account of high core loss and from danger of breakdown due to higher voltage. A lowering of 10 per cent will result in an increased all-day efficiency, but will reduce the full load loss efficiency, as well as cause the transformer to run hotter. The exciting current will increase with increased voltage, thus making the no-load current feed the transformers largely. The regulation at either non-inductive or inductive load will be improved.

The paper by Mr. R. T. McKeen on transformers considered the subject in a general way. The subject was first treated from the historical standpoint, and then the subjects of ageing, insulation and core and copper losses were taken up. He dwelt upon the importance of entirely separating the high and low potential windings by an insulation which will permit either winding to be completely destroyed without affecting the other coil. As to grounding, he recommended to make a ground connection at every house, but tapping the neutral of the three-wire circuit or one side of the two-wire circuit just before it enters the house, and carry the ground wire down the outside of the house to a water pipe in the basement. In conclusion Mr. McKeen strongly recommended that central station managers give the subjects of transformer insulation and ageing more consideration, and attach less importance to the core loss claims advanced for various types of transformers.

The paper by Mr. A. L. Mudge, on the operation of alternators in parallel, laid stress upon the point that machines to be thus operated should generate practically the same wave form. The generator should have a moderate amount of armature reaction. The smaller the armature reaction or the better the regulation, the larger are the cross currents flowing between the two generators and the more is the operation of the generators distributed by such currents. On the other hand, the larger the armature reaction or the worse the regulation, the less is the synchronizing current that can flow between the machines to bring them back into step. Generators having somewhat different regulations will operate satisfactorily in parallel if the field excitations of the different machines are properly adjusted as the load varies. In adjusting the field current of the different machines for increased or decreased load, the field current of the machine having the poorest regulation will always have to be varied through the widest limits. Two alternators belted to the same shaft will operate satisfactorily in parallel if care is taken that the pulley dimensions are such as to make the frequency of both machines exactly the same. A very slight error in this respect will make it necessary for one belt to slip more than the other all the while, and the generator running at the higher speed will take too large a proportion of the load. The paper, which is didactic in its nature rather than offering any new views on the subjects treated, goes very fully into the details of parallel operation.

The paper by Mr. William McKay gives suggestions for steam economy. He points out the quantity of different kinds of coal that may be burned per square foot of grate, the relation between grate and heating surface, the setting of boilers, the necessity of keep the tubes clean and the desirability of feed-water heaters. The primary considerations to be regarded in the selection of engines for particular work are also set forth.

Mr. William Bradshaw in his paper on the "Selection and Maintenance of Service Meters," considered the subject under the heads of mechanical construction, electrical characteristics, capacity and maintenance, giving a résumé of established practice in relation to the several matters.

Mica Production in the United States.

The total quantity of sheet mica produced in this country during 1904, as computed by Dr. Joseph Hyde Pratt, of the Geological Survey, was 668,358 pounds, valued at $109,462, an increase of 48,758 pounds in quantity, but a decrease of $8,626 in value, as compared with a production of 619,600 pounds, valued at $118,088, in 1903. It appears that in 1903 and 1904 the production was nearly 300,000 pounds greater than in 1901 and 1902. This large increase in the production of sheet mica during the last two years is due to the very large quantity of the small-sized disks and rectangular sheets of mica that have been prepared for electrical purposes.

The production of scrap mica during 1904 amounted to 1,096 short tons, value at $10,854, as against 695 short tons, valued at $6,460 in 1903. During 1903, however, there were also reported 964 short tons, valued at $18,580, which were sold in the rough blocks as produced. This probably made at least 800 tons of scrap mica, so that the actual production of scrap mica in 1903 was greater than that in 1904. Of the 1904 production 610,121 pounds of sheet mica, valued at $100,724, and 200 short tons of scrap mica, valued at $2,000, were produced in North Carolina. This was over nine-tenths of the total production of the United States in 1904.

Mica has been found in commercial sizes in about one-third of the States and Territories, but it was mined during the past year only in North Carolina, New Hampshire, Colorado, New Mexico, California, Georgia, South Dakota and Idaho, which are named in the order of their importance as mica producers.

The imports of mica have, in late years, been several times greater than the home production. This is partly due to the fact that mica from Canada and India, which can be entered at a low valuation, has a tendency to curtail the production of mica in the United States. During 1904 1,085,343 pounds of unmanufactured mica, valued at $241,051, and 61,986 pounds of cut or trimmed mica, valued at $22,663, were imported into the United States.

Modern Lightning Conditions.

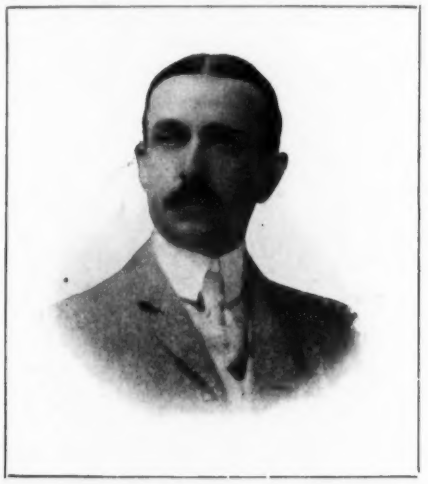
Mr. Kellingworth Hedges, secretary of the British Lightning Rod Commission, recently read a paper before the London Society of Arts, entitled "Modern Lightning Rods," giving a sketch of their history and present status. He commenced by giving a short history of the work which had been done since the first lightning conductor was erected by Procop Divisch, in Bohemia, in 1754. Then followed a *résumé* of the report of the Lightning Research Committee. Continental practice was carefully described, and it appears that national buildings in France, Germany, etc., are protected from

lightning to a much greater extent than those in Great Britain. A number of lantern views were thrown on the screen, depicting methods of installing lightning conductors in different countries. Photographs of buildings which have been damaged by lightning were also reproduced. In proposing a vote of thanks to the author, Mr. Gavey said that, at the present day, there was a greatly increased liability for houses to be struck by lightning owing to the masses of metal which it was customary to put in them. Years ago there were no bell and electric light wires or gas and water pipes such as now existed. There was a great similarity between lightning phenomena and the Hertzian waves used for wireless telegraphy. They were both of an oscillatory nature, and the inductive effects were similar in both cases. One was, in fact, a true analogue of the other. He was of the opinion that modern methods of installing lightning conductors afforded reasonable protection, and that the amount expended on such protection should be proportional to the value of the property to be protected.

Electrical Engineers of the Times.—XV.

M. K. EYRE.

Manning Kennard Eyre was born in Florence, Italy, where he remained until he was 10 years of age. His father and mother were both Americans, but met and married while traveling abroad. He received his early education at the Bishop College School in Canada, an institution modeled after the large public schools of England, and entered the U. S. Naval Academy in 1876 as a cadet midshipman. After graduation in 1880 he served in the Asiatic, European, Pacific and home squadrons, and while on shore duty took up ordnance as a specialty. In 1886 he was ordered to the U. S. Naval Academy at Annapolis as an instructor in ordnance and gunnery. In 1894 Mr. Eyre resigned from the naval service to enter the electrical field, and soon after became assistant to the manager of lamp sales for the General Electric Company. In 1895 he was appointed superintendent of the Edison Lamp Works of Harrison, N. J., and the latter part of that year became manager of the works. He was



M. K. EYRE.

also a member of the manufacturing committee of the General Electric Company.

Making a thorough study of factory organization, and particularly of manufacturing cost, Mr. Eyre was enabled very greatly to reduce the cost of the Edison lamp, while increasing its efficiency. At the time he became manager of the Edison Works nearly all the operations were done by hand, and lamps were exhausted by the old mercury process. Many of the present standard manufactory processes were developed at the Edison Works under Mr. Eyre's management, and the system of chemical exhaust introduced. Shortly after Mr. Eyre recommended the purchase and use of the chemical exhaust, companies in Europe which had previously adopted that system could not get good results and it was pronounced a failure; by a proper system of pay and proper management it was made a complete success at the Edison Works, both as to quality and economy.

In 1899 Mr. Eyre left the Harrison factory to enter into partnership with Dr. Louis Duncan in the practice of consulting engineering. During this time he spent several months in Europe investigating storage batteries for automobiles, being retained by the Electrical Undertakings Company of London, and also investigated and reported upon the lamp situation in Europe for the General Electric Company. Later he returned to the lamp field, taking charge of the Fostoria (Ohio) Lamp factory, and in four months after assuming responsibility he reduced cost 40 per cent. and placed the product on a plane where it was acknowledged to be among the best in the country. Upon the formation of the National Lamp Company, which was started by Fostoria interests, he became chairman of the manufacturing committee and later president of the Buckeye Electric Company of Cleveland.

Mr. Eyre's particular qualifications are in the line of organization and economy. He has made a special study of systems of pay, and he believes that very few factories give this subject anything like the attention it should receive. Although not an inventor, many improvements in the lamp business have been initiated and developed through his encouragement. Lieut. Eyre is a member of the American Institute of Electrical Engineers, and has lately become connected with the Sawyer-Man Electric Company, being now in charge of the lamp manufacturing department of that company.

CURRENT NEWS AND NOTES.

DEATH OF C. H. WELLMAN AND T. R. MORGAN.—As we go to press the newspapers report a shocking railroad accident at Mentor, Ohio, on Wednesday night, in which Charles H. Wellman and Thomas R. Morgan, of the Wellman-Seaver-Morgan Co., perished. Mr. Samuel Insull, of Chicago, was also on the train, but escaped injury.

TIRED OF MUNICIPAL OWNERSHIP.—A special dispatch from Monroe, Mich., says: "The Monroe City Council has apparently become sick of owning a municipal lighting plant. Some two weeks ago a proposition was sprung by City Surveyor White to lease the plant for ten years. Since that time other proposals have been presented and the Council at an informal session decided to hear further propositions. The Detroit, Monroe & Toledo Company also made a proposition to furnish power, and this seems to be the most feasible one, since they have plenty of current. A full report will be made by a committee. Monroe has had municipal ownership for five years."

CARNEGIE TECHNICAL SCHOOL APPOINTMENT.—Mr. Alexander Jay Wurts has received the first appointment to the faculty of the Carnegie Technical Schools, that of professor and head of department of applied electricity. In announcing the appointment, Director Arthur Hamerschlag said: "Mr. Wurts comes excellently equipped in electrical knowledge to assume the headship of the department of electrical practice in the school of applied science, and with his breadth of commercial, scientific and inventive experience, promises to establish a curriculum which will undoubtedly do much for the students wishing to specialize in this subject. His record will show that he is well prepared by education and experience to make this department of the school of applied science especially strong in its inception, and its true scientific foundation thoroughly practical in its relation to the industries of the community."

LONG ISLAND RAILROAD TELEPHONES.—It is announced that the Long Island Railroad is completing, in connection with the electrification of its western lines, a very thorough private telephone system, so that the electrical superintendent at Long Island City can keep constantly in touch with all portions of the system. These telephones will be scattered along the fifty miles of line, no two being more than 2,000 feet apart. There will be about 150 telephones, 100 being in special boxes similar to the police telephone boxes, and the rest in the switch towers and stations. The road telephones will all have direct connection with the electrical superintendent's office. The power house in Long Island City will also have direct telephone connection with all the five sub-stations. In connection with the telephone service the railroad will introduce a novel method of road inspection by emergency crews of four men that will constantly patrol along the line of electrification in gasolene motor cars running on the tracks. When the electric road opens there will be two of these crews, one stationed at Long Island City and one at Woodhaven Junction. When out on the road the crews will keep in touch with headquarters by means of the telephone and can always be summoned for any emergency work.

WIRELESS ON PACIFIC COAST.—Six sites for wireless telegraph stations between San Francisco and Cape Flattery, at the entrance of Puget Sound, are to be selected. It has been decided to recommend a site at Point Loma and another at Point Arguello, near Santa Barbara. The stations will be about 200 miles apart and will be under the control of the Navy Department.

FILM-COATED WIRE.—For the purposes of providing a metallic conductor with an insulating coating which will add but inappreciably to the bulk of the conductor and will have high insulation, J. G. Callan, according to a patent issued June 13, employs collodion as the insulating material. To prevent the collodion from acting chemically upon the wire, there is used a preliminary layer of lacquer or varnish, which completely covers the conductor.

WESTINGHOUSE-PARSONS STEAM TURBINES.—Seventy Westinghouse-Parsons steam turbines are now in operation in the United States, ranging in capacity from 400 to 5,500 kw. The first turbines were installed in 1899. In reply to an inquiry, Mr. C. R. Williams, general superintendent of the Madison Gas & Electric Company, which has been using a 400-kw. Westinghouse-Parsons machine since Oct. 26, 1904, said that it shows 45 per cent. less fuel cost than a 2,000-hp compound condensing unit in the same plant, and that there has been absolutely no trouble from the operating standpoint. Mr. Williams is installing another turbine of the same type at Madison, and two at La Crosse, Wis.

PRICE OF CURRENT.—The New York Edison Company announces a reduction in the price of current to 10 cents per kilowatt hour, in place of the old rate of 15 cents. Power rates vary accordingly. Moreover, there will be, as before, no charge for incandescent lamp renewals or for arc lamp supplies, and the company announces that "all incandescent and arc lamps that have been cut off, temporarily or otherwise, and all 16 candle-power lamps that have been replaced with smaller sizes to lower the installation equivalent, may be restored to service without effect upon the charge." It will be very interesting to see the effect on consumption of this material and sweeping reduction in rates, rendered compulsory by recent legislation.

TROLLEYS IN PERU.—U. S. Minister Dudley, at Lima, Peru, S. A., writes: "In pursuance of the authorization of a supreme resolution of April 12, a contract has been entered into between the Ferrocarril Urbano de Lima and the provincial council substituting overhead trolley for horse traction on all the street railways of Lima (about 16 miles in extent). The new system is required to be in operation within two years from the signing of the contract, and 5 kilometers (3.1 miles) of new road between specified points in the city must be in operation within the five following years. A new company, representing American and local capital, succeeds the old one, and the electric and other new material required has been ordered from the United States, as happened in the case of Lima's two suburban lines now in successful operation."

SPEED CONTROL OF REPULSION MOTORS.—For the purpose of controlling the torque, speed and direction of rotation of repulsion motors, G. Winter and F. Eichberg, according to a patent issued June 13, propose to provide the rotor with two sets of brushes, each angularly displaced with respect to the stator winding, and to insert a variable resistance in each brush circuit, whereby the relative amount of current in the two circuits may be controlled at will, so as to vary the speed-torque characteristic of the motor. If the current in one of the brush circuits is made less than that in the other, the torque due to the other current will preponderate to an extent dependent upon the difference in the strengths of the currents. When the motor is up to full speed, by removing the resistance from the short-circuiting connections the machine will operate as an induction motor.

THE STARTING OF REPULSION MOTORS.—Two patents issued June 13 to Leo Schuler relate to method and means for operating a modified form of repulsion motor. The rotor of the machine is provided with the usual commutator and short-circuiting device for converting the machine into an induction motor after sufficient speed has been attained. The novel features reside in the stator winding. Experience has shown that the best starting conditions are obtained when the angular displacement between the primary (stator) field and the rotor brushes is about 15 degrees, while with increase of speed greater torque is produced when the angular displacement is decreased. The inventor proposes to wind the stator in several parts, and to use such of the coils as are necessary to give the required angular displacement for the desired torque at low and high speeds. By means of a double-throw switch, the displacement is 15 degrees at starting and for low speeds, while for higher speeds the displacement is 5 degrees. When sufficiently high speed is reached, the commutator is short circuited and the machine becomes a single-phase induction motor.

SUBMARINE TELEPHONE SIGNALS.—Mr. W. R. Holloway, U. S. Consul-General at Halifax, N. S., reports as follows: "An inspector who has just returned from a tour of the buoys on the coast of Nova Scotia reports that the submarine bells which have been placed in position, one off Sambro and other off Egg Island, are working admirably. The bells can be heard at a distance of 5 miles, as tested by the Steamer *Laurier,* which is equipped with a receiving instrument on which the sound is heard. Submarine telephone signals will be established at several other points on the Nova Scotia coast, in the Bay of Fundy and on the Cape Breton seaboard. The department of marine has contracted for a large number of these well-tried and successful aids to navigation and they will be installed as rapidly as possible. It is expected tht all steamers running to Canadian ports will soon be supplied with the receiving apparatus which will enable approach to the coast with safety in all kinds of weather."

THE BRAKING OF REPULSION MOTORS.—In a patent issued June 13 to G. Winter and F. Eichberg is revealed an interesting characteristic of alternating-current commutator motors. The particular machine referred to is a form of repulsion motor which employs three windings, the usual rotor winding with brushes on the commutator directly short circuited upon themselves (referred to as the "induced" windings, a stator coil placed inductively to this winding (designated as the "inducing" winding), and a second stator coil in magnetic quadrature to the "induced" winding (called the "exciting" winding). In normal operation the "inducing" and the "exciting" windings are joined in series and connected to the source of supply, while the "induced" (rotor) winding has no electrical connection with the stator circuits. For the purpose of obtaining a strong braking action without any connection whatsoever to the source of supply, the present inventors propose to reverse the relative connections of the "inducing" and "exciting" windings and to join them in a circuit closed locally through a resistance. The generator action of the circuits when the rotor is traveling above a certain speed depending upon the resistance in circuit, causes currents to be sent through the stator coils. The current is alternating in value, the frequency depending on the inductive constants of the circuit. No information is given as to the cause of this action.

MARCONI SYSTEM PATENTS.—On June 13 there were issued four patents for improvements in wireless telegraphy, all relating to the Marconi system. A patent to Marconi relates to the arrangement of the circuits at the receiving station so as to render the detecting devices selective in their behavior. The elevated conductor is grounded by means of several connections of different inductance and capacity, instead of by one, as was the practice originally. Each local closed earth circuit contains capacity and inductance so adjusted that each circuit is responsive only to an electromagnetic wave of the chosen frequency. A patent to A. Gray refers to apparatus at the transmitting station. In order to prevent sparking at the circuit breaker for heavy alternating currents, the inventor provides an electromagnet excited by the alternating current, and arranges for this magnet to hold the circuit closed until the current reaches its zero value. An automatic signaling key is the subject of a patent to Professor J. A. Fleming. The key is held open by a spring against which pulls a band which passes loosely over a pulley driven by a fast-running motor. By means of an electromagnet the band is forced against the pulley when desired to depress the signaling key. The electromagnet is set into operation by means of a clock-work arrangement similar to that of a Morse printing instrument. A second patent to Prof. Fleming relates to the spark-gap at the transmitting station. The discharger surfaces consist of two balls, each of which is caused to rotate continuously, so as to eliminate the detrimental effect of the wearing away of the surfaces and thereby altering the character of the spark. All four of these patents have been assigned to the Marconi Wireless Telegraph Company.

Niagara Power in Toronto.

TORONTO is to receive 20,000 electric horse power from Niagara Falls over a line 75.5 miles long. Though the earliest of the electric plants at the Falls began operation in 1905, the delivery of water power in Toronto may be said to mark the first really long Niagara transmission. Buffalo, 23 miles distant by the line, has thus far been the most distant point reached by power from the Falls. At Toronto the entire electric supply system as well as the street car lines are to be operated with the transmitted energy, and plans call for an immediate delivery capacity of 20,000 hp.

The transmission line from Niagara Falls terminates in a substation at the intersection of Davenport Road and Huron Street, close to the Canadian Pacific Railway, and just outside of the city limits, as seen in the map, Fig. 1. From this site to the lake front in a direct line the distance is some 14,000 ft., and it lies about midway of the length of the city east and west. At this substation the pressure of the transmitted current is transformed from about 60,000 to some 12,600 volts, and the distribution at this latter pressure to other sub-

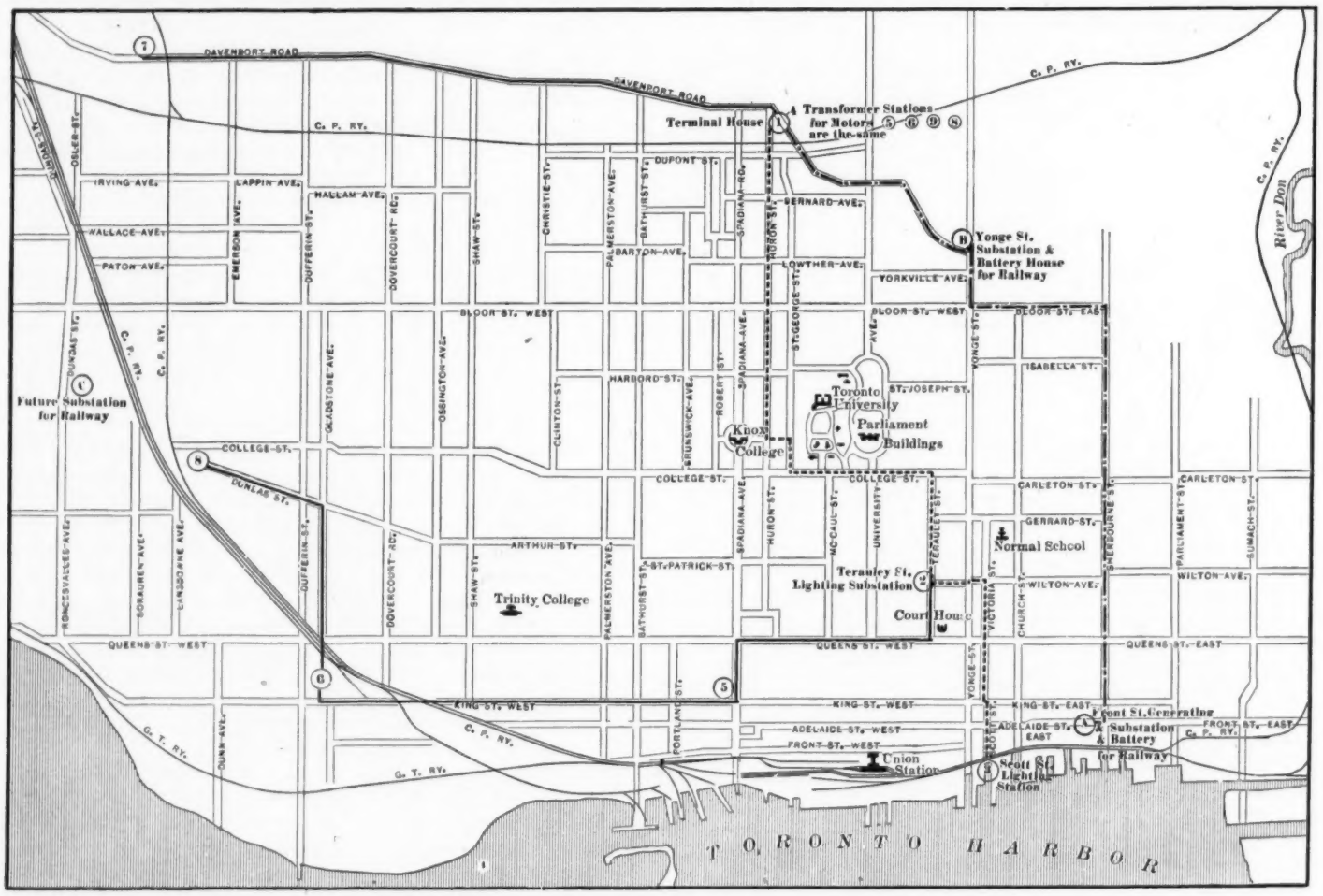


FIG. 1.—MAP OF TORONTO, SHOWING LOCATION OF SUBSTATIONS.

stations begins. This distribution extends to four main substations with converting as well as transforming equipments, and to several substations where only transformers are located. Two of these converting substations supply lamps and stationary motors, and two operate the electric railway system.

Electrical supply in Toronto, as in many other cities, was at one time carried on by competing interests, and this condition resulted in the erection of two steam-power stations, one on the lake front at the foot of Scott Street and adjoining the tracks of the Canadian Pacific and Grand Trunk Railways, and the other on Terauley and Agnes Streets about 4,000 ft. from the railway and a little more than that from the lake. Between these two stations the distance is about 5,000 ft. and each one is within 3,000 ft. of the most compact business section of the city. Consolidation has brought these two stations under common management, and in each the power transmitted from Niagara Falls will largely, if not entirely, displace steam.

At the Scott Street station on the water front, which was first in the field, the electric generating equipment includes direct-current, constant-pressure dynamos of 125 volts and 275 volts respectively, series arc dynamos, and 2,400-volt, 60-cycle, single-phase alternators. The 125-volt dynamos have an aggregate capacity of 1,200 kw in six machines, the 275-volt dynamos are the equivalent in capacity of 3,600 kw, the six alternators are rated at 400 kw each, making their total 2,400, and there is a capacity for 2,000, 9.6-amp open arc lamps, or about 1,000 kw in arc dynamos. These figures give the Scott Street station a total dynamo capacity of 8,200 kw. At the Terauley Street station the equipment consists entirely of 125-volt, direct-current dynamos with a total rating of 1,000 kw.

From the Terauley Street station there are operated incandescent and arc lamps, and motors on a 2 x 125-volt, three-wire system. The steam engines at this station are of the simple and non-condensing type. The water for the boilers comes from the city mains. At the Scott Street station water for the boilers and for the condensers is pumped from the lake. Another advantage of this latter station is its coal wharf, where 12,000 to 15,000 tons of coal from the lake have usually been stored each Autumn.

Four sorts of distribution service are supplied from the Scott Street plant. The 125-volt dynamos there operate a 2 x 125-volt, three-wire system, mainly for commercial incandescent lamps. The 275-volt dynamos operate another three-wire system exclusively for motors, and these dynamos are used on the outside wires of the 2 x 250-volt circuits at times of heavy load. Single-phase, 60-cycle current is distributed for incandescent lighting, more particularly in the outlying districts of the city. Arc dynamos in the Scott Street plant operate open arc lamps mainly for street lighting.

Some changes will be made in these lines of service with the introduction of Niagara power. The 2,400-volt, 60-cycle circuits will remain single-phase, as at present. Circuits of 2 x 125-volts, three-wire, are to be discontinued, and the 2 x 250-volt circuits are to supply both the lamps and the motors, incandescent lamps of 250 volts being substituted for those now in use at about 125. In the central business portion of the city bounded by Bay, College and Sherbourne Streets and Spadina Avenue, both lamps and motors will continue to be supplied with direct current. This business section where direct-current distribution is to be continued measures only about 4,000 ft.

parallel with the lake front, and a little more than this on a line running back from the water.

Toronto has a width of about 14,000 ft. at right angles to the lake front, and extends for more than twice that distance east and west. As there are many factories in the outlying portions of the city, a new motor service with three-phase, 25-cycle current at 600 volts is to be provided for scattered motor loads. Circuits for this service will be run from some four or five transformer substations located in various parts of the city, and as each of these substations

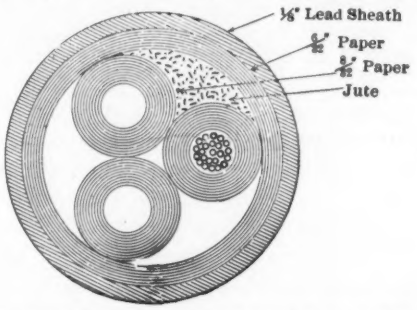


FIG. 2.—12,000-VOLT, 3-PHASE CABLE AT TORONTO.

will contain no moving machinery the constant presence of attendants will not be necessary.

The transformer station on Davenport Road, near Symington Street, will be connected with the terminal station by an overhead line along a course outside of the city limits. Underground cables from the Terauley Street substation will deliver the 12,000-volt current to all of the other transformer stations except the one at the terminal station.

From this terminal station the 12,000-volt current from the step-down transformers is carried by four lead-covered cables, which run first to the Terauley Street sub-station, and then go on to the steam and sub-station at Scott Street. In the Terauley Street sub-station these cables connect with four 1,200-hp, 12,000-volt synchonous motors. Each of these motors is direct-coupled to a 400-kw, 250-volt, direct-current dynamo at one end of the shaft, and to a 400-kw, 2,400-volt, 60-cycle, three-phase alternator at the other end.

At the Scott Street generating and substation the four cables connect with two banks of transformers that reduce the pressure from 12,000 volts to that for two 500-volt, 100-kw, rotary converters. The total converting capacity at the two substations is thus 4,200 kw. At the Scott Street station there is also to be installed two Curtis steam turbines, each with an alternator rated at 2,000 kw and 12,000 volts, 25-cycle and three-phase. These turbine generators are intended

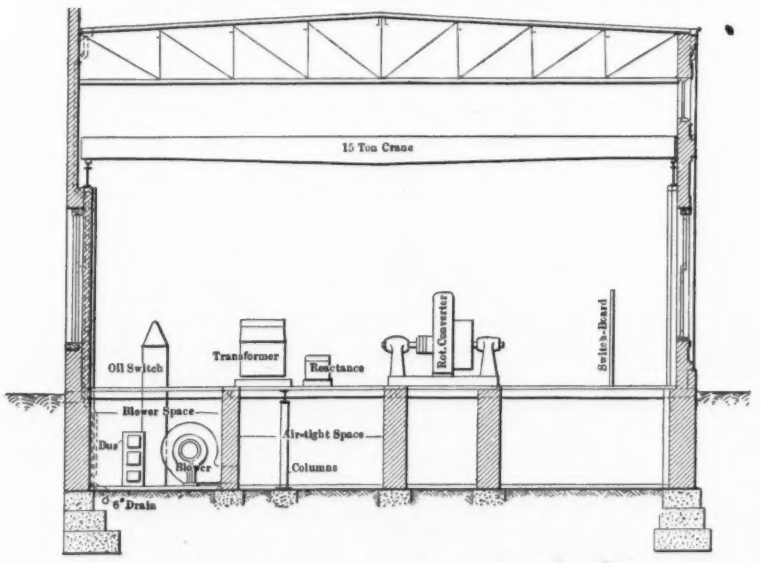


FIG. 3.—CROSS-SECTION OF YONGE STREET SUB-STATION.

as a steam reserve, and it may be noted that their voltage limits their application to the converting equipments before noted, and to the transformers for motor service.

Each of the four cables that connect the terminal station with the several substations contains three copper conductors, each made up of 19 wires, with a combined cross section equivalent to No. 00 wire. About each of these three conductors there is a wrapping of paper ¼-in. thick, and around the group of three conductors there is a layer of paper 3-16-in. thick. Outside of this layer of paper comes the lead sheath with a radial thickness of ⅛-in., and an external diameter of 2⅝-in. Between the insulated conductors and the encircling layer of paper the spaces are filled with jute. The arrangement of the conductors and insulation is shown in Fig. 2.

At the Terauley Street sub-station the 250-volt dynamos will operate two in series on the three-wire system, and at the Scott Street station the 500-volt rotary converters will be connected to the outside wires of the same system. The 2,400-volt, 60-cycle, three-phase alternators at the Terauley Street sub-station will carry the lighting load in outlying districts. Arc dynamos will continue to operate the series circuits of street lamps, but these dynamos will in the future be driven by induction motors. Each of the sub-stations for motor service only will have a capacity of about 1,000 kw in transformers.

The present lighting load at Toronto includes about 60,000 incandescent lamps on the direct-current, 2 × 250-volt main; 90,000 incandescent lamps supplied from the 2,400-volt, 60-cycle, single-phase lines, and the open, 9.6-amp arc lamps operated by dynamos of 2,000 lamps capacity. About 1,200 direct-current motors, that range up to 110-hp. each in capacity, are operated from the 250 and 500-volt, three-wire lines.

Another set of cables like those before named starts from the terminal station of the Toronto & Niagara Power Company, and runs by the way of Davenport Road to a substation of the Toronto Railway Company on Yonge Street. From this substation the cables pass along Yonge to Bloor Street East, and thence to Sherbourne Street, which they follow to the steam and substation of the railway at the lake front. The total length of this cable route is about 17,000 ft.

At the substation on Yonge Street, a cross-sectional view of which is given in Fig. 3, the cables connect with three groups of transformers, each group consisting of three 350-kw transformers that reduce the voltage from 12,000 to that for a 500-volt, 1,000-kw rotary converter. At this substation the converters of 3,000 kw total capacity connect with the railway feeders. In the steam and substation at the water front the 12,000-volt underground cables connect with five groups of transformers, each group having a capacity of 1,050 kw and supplying current to 1,000-kw rotary

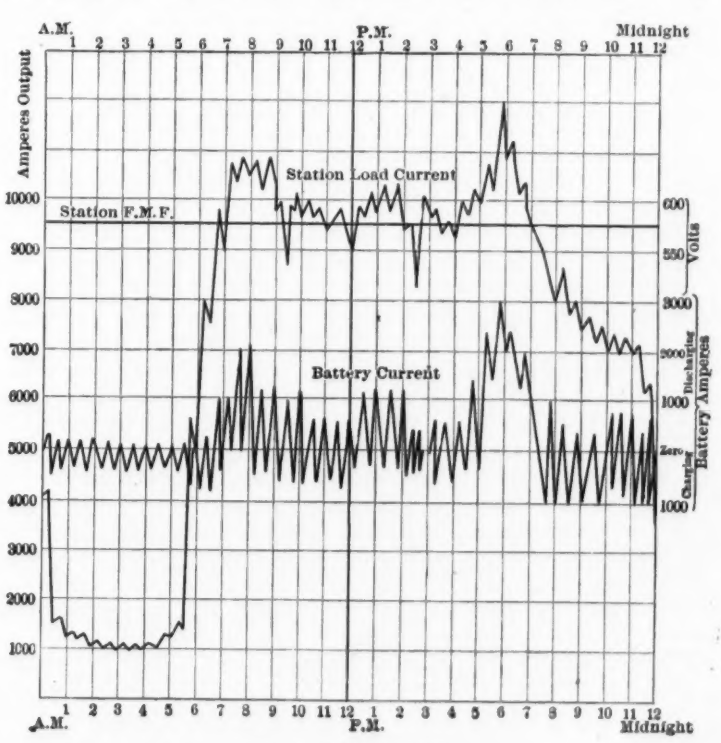


FIG. 4.—LOAD CURVES.

converter. The combined capacity of converters at these two sub-station is thus 8,000 kw.

At High Park Avenue it is probable that another substation, with a converter capacity of 1,000 kw, will be located for the railway line in the west end of the city.

Across the street from the steam and substation on the water front, there is a battery-house with storage batteries of 4,000 amp-hour capacity at 550 volts. On the basis of one hour discharge rate this battery has a capacity of 2,200 kw. Near the Yonge Street

substation is located another battery-house, which will contain another battery of 4,000 amp-hour capacity for the street railway.

On February 14, 1905, the Toronto street railway was operated by the steam generating station, on the water front, and by the storage battery close to it. During the twenty-four hours of that day the average amperes delivered to the railway system from generators and storage batteries were 8,653, at 575 average volts. (See Fig. 4.) The maximum amperes delivered by the generators reached 12,000, the maximum battery load was 3,000 amperes, and the maximum load of the system was 15,000 amperes. The maximum generator load of 12,000 amperes at 575 volts represents 6,900 kilowatts. It seems, therefore, that the 8,000 kw in capacity of rotary converters to be installed at the steam generating station and in the Yonge Street substation, together with the two storage batteries, will be somewhat in excess of present requirements.

The two houses for the 4,000 amp-hour batteries are of nearly the same design, each being a one-story brick building, with tile floor laid on concrete, and a tar and gravel roof supported on wooden timbers. For the battery-house on Front Street near the steam generating station the length is 126 ft. 5 in., and the width 67 ft. 6 in. outside. Like the other house this one has a monitor with side windows running along the center of its roof in the direction of greater length. From tile floor to the lowest point of roof timbers the height is 18 ft. In its interior the house is divided into three bays by two rows of wooden posts that support the roof timbers, and there are two rows of battery cells in each aisle. Five rows contain 45 cells each, and the sixth row 48 cells, all of the 273 cells being connected in series to feed the railway lines.

On Yonge Street the new battery-house measures 101 ft. 9 in.

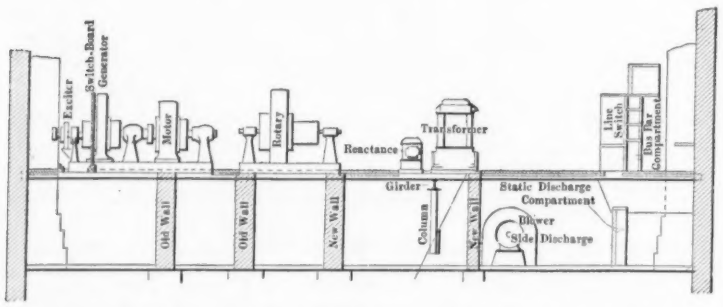


FIG. 5.—GENERAL ARRANGEMENT OF FRONT STREET SUB-STATION.

in greatest length, and 67 ft. wide, outside, exclusive of the boiler-room. The six battery rows contain 276 cells in all. In each house there are three six-inch sewers between the six rows of cells, and catch-basins connect with these sewers at intervals of 15 ft.

At the Front Street generating station of the railway system some changes have been made by which a space about 80 ft. long and 64 ft. wide is devoted to the transforming and converting apparatus. On one of the longer sides of this area the 12,000-volt, three-phase oil switches and busbar compartments are located on the main floor, with the static discharge compartments underneath in the basement. (See Fig. 5.) Parallel with the row of oil switches comes that of the 15 350-kw air-blast transformers that step down the 12,000-volt current for the rotary converters that feed the railway at about 575 volts. The motor-driven blowers for these transformers are in the basement beneath. In another parallel row, distant about 9 ft. from the transformers, are the five 1,000-kw rotary converters, and beyond these is the switchboard, with connections to the railway and battery feeders. At one end of this board sets a motor-driven booster for the railway feeders.

The new railway substation on Yonge Street (Fig. 3) is a nearly rectangular building, 53 ft. 8½ in. wide, and 90 ft. 11¾ in. long, both dimensions taken inside. In height above the ground outside the substation measures about 34 ft. to the edge of the roof, and the height inside from the main floor to the lowest cords of the roof trusses is also 34 ft. Beneath the main floor is a basement with a height of 9 ft. 6 in. The construction of this building is fireproof to a high degree, the walls being of brick, reinforced with steel columns, the floor of concrete on steel beams, and the roof of tile supported by steel I-bars and trusses and covered with tar and gravel. A 15-ton crane sweeps almost the entire area of the station inside. The main floor is designed to carry five 1,000-kw rotary converters and 15 350-kw transformers, which are connected in groups of three for serving the rotaries.

It may be noted that the capacity for 5,000 kw in rotary converters at this substation is the same as that at the substation on Front Street, so that the ultimate capacity of equipment at these two substations will reach 10,000 kw exclusive of the booster sets.

The transformers and converters at the Yonge Street substation are arranged in two parallel rows in the central portion of the main floor.

On the longer side of the substation next to the transformers is the row of 12,000-volt, three-phase oil switches, and beneath these in the basement are the compartments with busbars of equal voltage. Along the opposite side of the station is the switchboard for railway feeders, which receive current from the rotary converters at about 575 volts. Space at one end of this switchboard is provided for a motor-driven booster. Each group of transformers is provided with a reactance. Beneath the row of transformers there is an air-tight chamber, 13 ft. wide, in the basement, and an air pressure for the transformers is maintained in this space by a motor-driven blower near one end.

The transformers, motors, converters and turbine generators above named are being supplied by the Canadian General Electric Company.

The foregoing facts as to the lighting and railway situation in Toronto have been obtained through the courtesy of Mr. Frederic Nicholls, of both the Toronto Electric Light Company and the Toronto Railway Company; of Mr. J. J. Wright, Manager of the lighting company; of Mr. R. G. Black, Electrical Engineer, of the same company, and of Mr. W. A. Fiske, Resident Engineer, of the railway company. Before the close of the present season it is confidently expected that the great bulk of electric loads in Toronto will be operated with power from Niagara Falls.

Electromagnetic Wave Detectors.

In a recent lecture at the Royal Institution Prof. J. A. Fleming described various devices for detecting electric waves sent out into space from the antenna, and explained the action of coherers and anti-coherers. The magnetic detector, originally suggested by Rutherford and developed into a practical and highly sensitive device by Marconi, was then dealt with, its action being explained by diagrams. Turning then to the electrolytic detectors, the lecturer described in detail the Schloemilch type of electrolytic detector in which an exceedingly fine platinum wire dips into an electrolyte. This detector is inserted in a local circuit and the electrolytic action of the local current causes the fine point of the platinum wire to be coated with a thin layer of gas. Thus the local current is interrupted. The layer of gas is broken down, however, when the detector is exposed to the action of electric waves and the local current flows instantly, but is interrupted by the renewed evolution of gas when the electric waves cease. The lecturer himself has devoted much time to the development of a detecting device which makes use of a sensitive galvanometer. To this end the alternating current in the receiving air wire has to be converted into a unidirectional current, as a galvanometer does, of course, not act with an alternating current. The auxiliary device consists of an incandescent lamp with a very high vacuum, and the filament is surrounded by a metallic cylinder. It is found that current will only pass in one direction between the filament and the metal cylinder. Such a device has been named an "oscillation valve." The inductive transformation of electric oscillations and the inductive coupling of circuits were next explained with the aid of mechanical analogies. It was then shown how circuits could be tuned to each other by adjusting their capacities and inductances, and how this could be made use of for measuring the length of electric waves. The wave-measuring instrument of Prof. Fleming's design was shown in operation. A straight conductor, connected up to an adjustable capacity and inductance, is placed near to and parallel with the air wire the wave in which it is desired to measure. The capacity and the inductance are then adjusted until the two circuits are tuned, i. e., until maximum current flows in the circuit. The frequency and wave length are calculable from the capacity and inductance, but in practice the necessity of this calculation is avoided by giving the instrument a direct-reading scale.

Booster Field Control.

BY CARL P. NACHOD.

THE following method of controlling a separately excited booster field, while not new, seems not to have the general use that its conveniences justifies.

It has been found especially advantageous for obtaining extremely small currents from a constant potential source for separately exciting a booster field. It requires but an ordinary field rheostat with an extra terminal, T (Fig. 2), though by the addition of a second low-resistance rheostat, large field currents can be handled as well.

The circuits are shown in Fig. 1. The rheostat is connected permanently across the exciting mains, and the booster field coil has one terminal joined to one of these mains, and the other terminal to the arm of the rheostat. According to the position of the latter, the field coil may receive a voltage varying from zero to the maximum of the line.

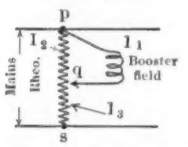


FIG. 1.—SCHEME OF BOOSTER FIELD CONTROL.

The practical connections are shown in Fig. 2. Here a switch is employed to reverse the polarity of the field, while an additional low resistance rheostat, N, serves for finer adjustment of the higher field currents. In the curves shown this rheostat, N, is supposed to remain with its resistance all cut out.

Data will be assumed as in Fig. 2, viz.:

E.m.f. across exciting mains, 120 volts.

Resistance of booster field coil, 40 ohms.

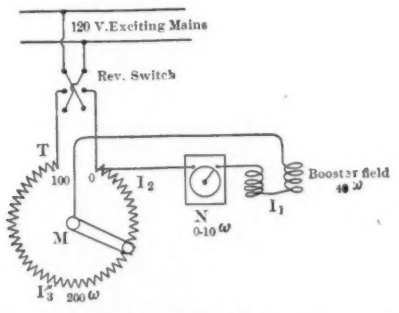


FIG. 2.—CONNECTIONS FOR BOOSTER FIELD CONTROL.

Resistance of rheostat, M, 200 ohms.

Resistance of rheostat, N (0 — 10) ohms, 0 ohm.

It will further be assumed that rheostat M has 100 steps, and that these steps are tapered so as to make the field current proportional to the position of the arm, the assumption being made, however, that the rheostat is connected simply in series with the field coil.

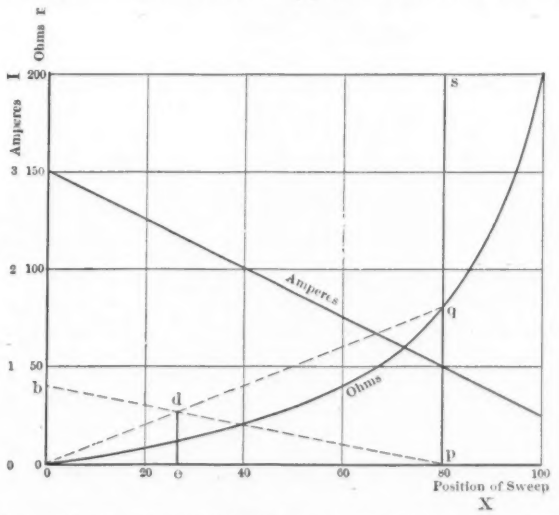


FIG. 3.—CURVE SHOWING GRADUATION OF RESISTANCE STEPS.

This is approximately the condition fulfilled by the ordinary field rheostat.

To obtain this stepping, draw a straight line for the current curve (Fig. 3), with amperes as ordinates and positions of the arm as abscissæ, the maximum current being $\frac{120}{40} = 3$ amperes, and the minimum $\frac{120}{40 + 200} = \frac{1}{2}$ ampere. The necessary resistance in the rheostat at any step must be

$$r = \frac{120}{I} - 40$$

from which is plotted the resistance curve, Fig. 3, which gives the required stepping.

Returning now to the connections shown in Figs. 1 and 2, sufficient data are at hand to plot the currents I_1 in the booster field coil, and I_2 and I_3, whose circuits are shown, for each position of the arm.

It will be seen from Fig. 3 that on any line, such as pqs, representing 200 ohms—the resistance of the rheostat—the point q indicates the position of the arm along the resistance, and that pq and the booster field coil of 40 ohms are in parallel with each other and in series with qs. The combined resistance of pq and 40 ohms in parallel may be obtained graphically by laying off $ob = 40$ ohms vertically at any point, say, the origin, and drawing bp and qo, de being the required resistance. Adding this to qs gives the total resistance in circuit. Dividing 120 by qs, there is obtained the corresponding point on the current curve I_3, Fig. 4.

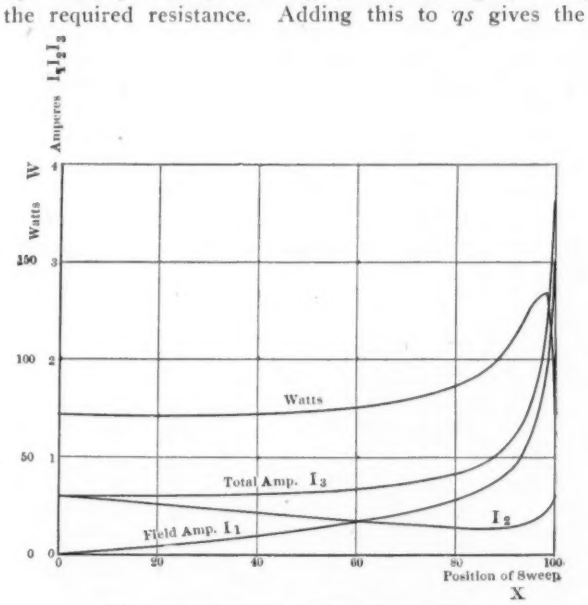


FIG. 4.—CURRENT AND POWER CURVES.

Having the resistance and current in the part of the circuit I_3, the drop is found as the product of the two. The drop over the parts I_1 or I_2 is 120 minus this product. The resistance of the part I_1 being 40 ohms, the current I_1 in the booster field coil may be found (Fig. 4).

The current I_2, which is the current not directly useful, equals the drop over that part, I_2, divided by its resistance, pq. Or it may be found by subtracting I_1 from I_3, as is evident from Fig. 1. The values of I_2 are shown in Fig. 4.

The values of the current, I_3, are useful in determining the maximum the rheostat would have to carry. A curve, W, is also shown, giving the watts in the rheostat for each position. It is made up of the sum of I_3^2 times the resistance of qs and I_2^2 times pq.

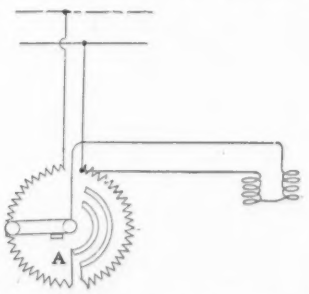


FIG. 5.—IMPROVED BOOSTER FIELD RHEOSTAT.

On examining the booster field current, I_1, it will be noted that it increases from zero up to about ½ ampere, gradually, and nearly in a straight line, and that it increases very rapidly at the extreme positions, where, in order to get a fine adjustment between steps, it is necessary to use the auxiliary rheostat N in series with the field coil.

A better design of the rheostat would be one in which the connections remain as shown in Fig. 1 until the field current changes too rapidly, after which further movement of the arm would change to the ordinary series connection. This would obviate any waste of current when large values of field current were required.

The scheme is shown diagrammatically in Fig. 5, in which, when the arm is on the right-hand side for small field currents, the switch, *A*, is (automatically) closed, and the shunt connection made, and, when it is on the left-hand side for large currents, the switch is opened and the series connection made.

Characteristics of a Holtz Machine.

BY H. DINGLE AND J. S. KNOWLSON.

AT the present day the use of the Holtz machine by physicians, surgeons and scientists all over the country has called more or less attention to its construction and operation, but little attention has as yet been directed toward the relation existing between the current, output and voltage.

The data for the accompanying characteristic curves were obtained with a four-plate Wagner Holtz machine. The machine consisted of two revolving mica plates 28 inches in diameter and two glass plates 31 inches in diameter. The whole was mounted in a glass case on a firm oak base. A motor drove the plates at a maximum safe speed of 2,000 r.p.m.

One terminal of the machine was grounded. A wire from the other was led through a D'Arsonval galvanometer to one of a pair of long vertical wires. The second of these wires was also grounded. By shifting the distance between the two wires the load on the machine could be varied at will. A Kelvin electrostatic voltmeter with one terminal to ground and the other connected to the charged wire just outside the galvanometer served to measure the voltage.

The data collected were plotted as curves between current and voltage for different speeds as shown in Fig. 1.

From these curves it appears that the Holtz machine delivers a constant current for a very considerable range of voltage. When, however, the current begins to diminish it does so very rapidly, probably due to internal leakage over all parts of the machine.

The variation of these curves with the change in speed is very regular, each successive curve having practically the same form, but dropping below the preceding one. This condition does not hold, however, for speeds under 550 r.p.m. At speeds below this value the machine is apt to break down, i. e., to lose its charge, and to become incapable of exciting itself.

The relation between current and speed for different voltages is shown in the lower half of Fig. 2, while in the upper half of the same figure are curves showing the variations of voltage with the speed for different constant values of currents. Both of these sets of curves were derived from Fig. 1 and need no explanation. It may well be noticed, however, that in the curves between voltage and speed for a given current, the voltage rises rapidly with the speed, up to a certain limit, and then increases very slowly. The point at which the voltage ceases to increase rapidly indicates the speed at which the machine should be operated for best performance at a given current.

Fig. 3 shows, in addition to the characteristic curve for full speed, a curve for the watts output of the machine and another for its efficiency. The input taken was the input to the motor which drove the Holtz machine. Hence, the efficiency includes the efficiency of the motor.

While each individual Holtz machine will have its own characteristic behavior, the curves here presented furnish an idea of the general character of such curves for all Holtz machines.

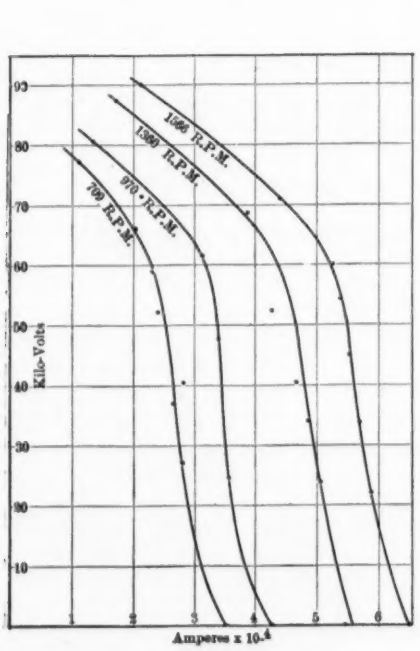


FIG. 1.—CHARACTERISTICS OF HOLTZ MACHINE AT VARIOUS SPEEDS.

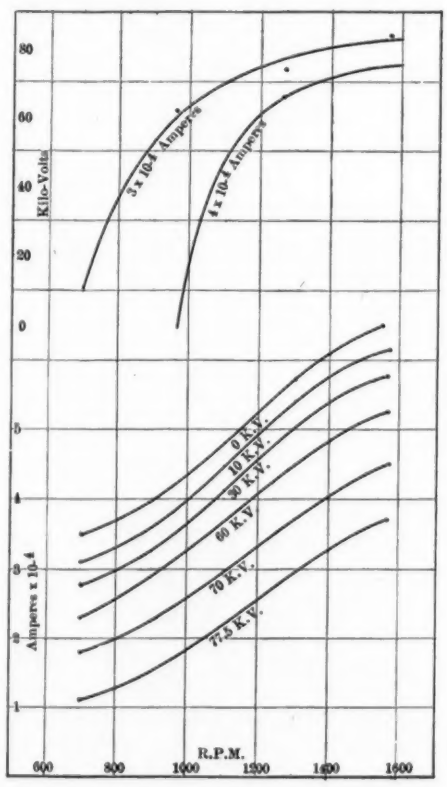


FIG. 2.—CHARACTERISTICS OF HOLTZ MACHINE AT VARIOUS VOLTAGES AND AMPERAGES.

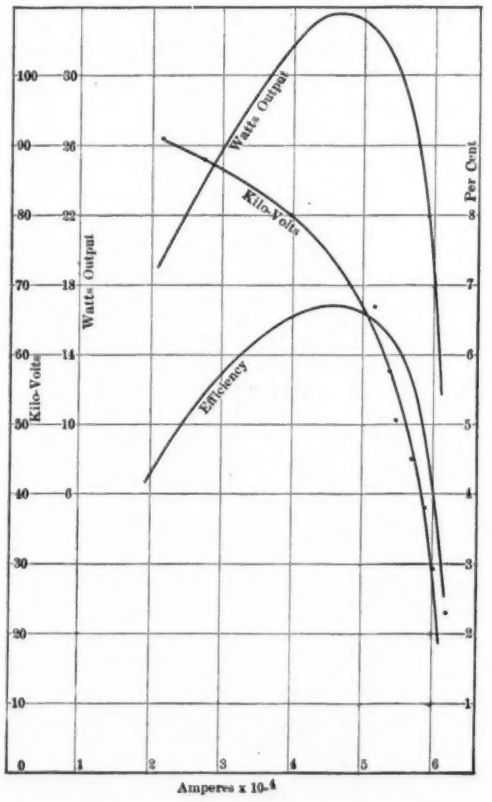


FIG. 3.—LOAD CHARACTERISTICS OF HOLTZ MACHINE AT CONSTANT SPEED OF 1510 R.P.M.

Meter Nomenclature.

In a letter to the London *Electrician* on the subject of an editorial note, reprinted in these columns, directed against the term "integrating wattmeter," and suggesting simply "meter" as a substitute, Mr. Kenelm Edgecumbe points out a growing tendency to allude to all the measuring instruments on a switchboard as "meters," and that it would certainly seem legitimate to describe voltmeters, wattmeters, etc., collectively as "meters.' This is all the more allowable as the American custom of making the word "instrument" include circuit-breakers and such like apparatus, appears to be gaining ground, and there is certainly something to be said for the practice. But even worse than the "integrating wattmeter" is the enormity which several well-known consulting engineers still commit in their specifications—namely, the use of the term "recording wattmeter" or even "watt-meter" to denote watt-hour meter. It seems that the term "recording" should be reserved exclusively for instruments which record by means of a line traced upon a paper chart, or by some similar device.

Asheville General Meeting of American Institute of Electrical Engineers.

BELOW are given abstracts of twenty-three of the twenty-four papers presented this week at the general meeting of the American Institute of Electrical Engineers at Asheville, North Carolina. The paper lacking from this report is that of Mr. C. E. Waddell, entitled "The Preservation of the Southern Streams; a Forest Problem," an abstract of which will appear in a following issue.

Elsewhere will be found a telegraphic report of the proceedings of the Asheville meeting up to the time of going to press. An extended account of all proceedings will be printed next week.

HIGH-POWER SURGES IN ELECTRICAL DISTRIBUTION SYSTEMS OF GREAT MAGNITUDE. BY C. P. STEINMETZ.

The paper gave a review, investigation and discussion of a high-power surge which occurred in the high-potential distribution system of the Manhattan Railway in New York, July 23, 1903. After giving an outline of the circuits and a description of the surge as observed by the operating engineers, the author remarks that the most characteristic feature was the enormous volume, and relatively very low frequency, of the oscillating surge occurring in the system. This explains the severity of the destruction and its widespread extent. Any oscillation of very high frequency could be local only and could not extend over any considerable part of such a system, since the high capacity of the cables necessarily would act as a short circuit to any very high-frequency oscillation.

The trouble was undoubtedly started in the manhole next to the power-house by a spark discharge between one of the conductors of a feeder and the cable armor, possibly due to the gradual breaking down of a weak spot in a cable-joint.

This spark discharge between conductor and cable armor, or ground, was oscillating in character, local in extent, and of moderate power and pressure, but of rather high frequency. It was the discharge of a condenser of a pressure equal to the pressure between conductor and ground; that is, the Y pressure of the system, or about 6,400 volts, and the capacity and inductance between the cable conductor and ground. The capacity and inductance, however, in this case, were distributed.

The author then develops general equations for the surges in electrical circuits in accordance with the methods indicated in his "Alternating Current Phenomena," and substitutes for the general constants the values determined for the Manhattan circuits. He finds two wave trains which alternate with each other, and so cause a successive series of impulses of high electromotive force, but zero current, and of high current, but of zero electromotive force to run along the circuit, starting from the fault and traveling towards the sub-station. The duration of the successive periods of current and of electromotive force depends on the conditions existing at the starting point of the wave; that is, at the fault in the manhole, but not directly on the constants of the rest of the circuit, and as a rule the duration of the period of high electromotive force and the period of high current are not equal. These waves of current and electromotive force which travel along the circuit from the source of disturbance, with high fequency, are in their simplest form flat-topped with steep wave front and back. The steepness of wave front and back depends upon the rapidity with which the arc establishes itself and ruptures, and also upon the distance from the starting point. Taking the resistance and conductance of the line into consideration shows a gradual rounding off of the wave with the increase of distance from the starting point.

Where these waves meet obstructions, as localized inductance, the steepness of the wave front results in the induction of high electromotive forces of very limited extension, and gives the pyrotechnic displays observed at the switchboards of high-pressure stations when there is a disturbance on the line, which sometimes are called "static." Due to their very limited power, these phenomena are relatively harmless of themselves; their danger rather lies in producing or establishing a path for short circuits or surges of high power, as happened in the case under discussion.

Localized inductance offers some protection to the system against these waves even if the inductance is very small.

It seems that in an electric circuit containing distributed capacity and inductance, as in an underground cable, a long-distance transmission line, or in the high-pressure winding of a transformer or high-pressure generator, three distinct frequencies must be recognized that are essentially independent of one another.

(1) The impressed frequency supplied by the generating system, or 25, 40 or 60 cycles as fundamental, and their odd multiplies as higher harmonics or wave-shape distortion, which higher harmonics are usually of small or even negligible magnitude.

(2) The frequency of oscillation of the system, or natural period of the circuit, depending on the constants of the circuit, mainly the capacity and the inductance, and consisting of a fundamental frequency $N_1 = \frac{1}{2\pi\sqrt{L_0 C_0}}$ and all the odd multiples thereof as higher and higher harmonics depends on the distribution of pressure and current in the circuit at the moment when the oscillation starts. As a rule the higher harmonics are not negligible, but usually rather predominate.

(3) The frequency of circuit disturbance, which has no direct relation to impressed frequency or to the natural period, but depends upon the character of the disturbance. It appears as a system of waves traveling along the line, and results in the static displays at the end of the line; that is, at the station switchboards. In its simplest form, as a single wave or impulse traveling along the circuit (frequently visible to the eye as a luminous streak), it probably appears when a moderate lightning flash or side discharge strikes at a transmission line, and from there to the ground, giving at the point of impact a sudden rise of pressure against ground, immediately relieved by the discharge to ground.

This phenomenon, so far as known, has never been investigated from the theoretical point of view. While of itself rather harmless, its danger consists in the self-destructive forces that it may set into play. In the circuit under discussion here the impressed frequency is 25 cycles, the natural period 2,670 cycles. The frequency of the static display is 13,000 cycles, but of such steep wave front as to correspond to a far higher frequency, possibly of the magnitude of 200,000 cycles per second.

In the breakdown in the Manhattan system, starting with a spark discharge between conductor and cable armor in a faulty joint in the manhole near the power-station, attention was called to the disturbance by the arrival of the wave trains and the resultant static displays on the cables and switchboards of the next sub-stations. No direct harm was done by this "static," but before the fault could be located and cut out, the spark discharge had reached the next conductor of the cable and started a short circuit between two conductors. With six generators of 500-kw. rating and a momentary maximum of 12,000 kw. each, and the synchronous converters feeding back into the short circuit as evidenced by the opening of the reverse-current relays in the sub-stations—it probably is a conservative estimate to assure that for a short period a power of 100,000 kw. was concentrated in the short-circuiting arc in the manhole. The energy of 100,000 kw applied during only one-tenth second equals the explosion of about half a pound of dynamite.

The explosion tore off the insulation and protection of the conductor, and a flaring arc started in the manhole, and being oscillating or self-rupturing in character, created a surge of low frequency and enormous power in the whole system, beyond the disruptive strength of any part of the system or any protective device. This short-circuit oscillation was a surge of the whole system throughout, and almost instantaneously caused breakdowns in all the feeders, cables, cable-bells, transformers, generators, etc. The static protectors apparently discharged and somewhat lowered the pressure, but could not be expected to take care of the enormous volume of the surge. Some burned up explosively, due to the excessive pressure imposed upon them.

AN EXPERIMENTAL STUDY OF THE RISE OF POTENTIAL ON COMMERCIAL TRANSMISSION LINES DUE TO STATIC DISTURBANCES CAUSED BY SWITCHING, GROUNDING, ETC.

BY PERCY H. THOMAS.

In studying static discharges, the most important information to be sought is the resulting maximum potentials at various points in the system, the average or effective value being of little importance. The exact determination of the maximum values of extremely rapid discharges is by no means an easy matter. The motion is, of course, too rapid for any mechanical instrument to respond, and no magnetic or optical means is readily available.

The most convenient measure is the spark-gap, which is widely used for this purpose, and though it is not possible to get very accurate measurements from a spark-gap, an approximate indication of the maximum voltage may be obtained by this means. In the tests hereinafter described such gaps were used to measure the maximum potential.

In order to prevent the discharge from one gap interfering with the circuit as a whole and thus influencing discharges at other gaps, condensers were placed in series with all the gaps. The condensers, though small in static capacity, had a very considerable capacity as compared with that at the air-gaps, so that the gaps received the major portion of the potential impressed on the measuring device as a whole. Calibrations were made with the gaps in position and in series with the condensers. It was found convenient to use two different sizes of condensers.

Furthermore, since the result of any operation that is independent of the generator electromotive force, such as switching, short-circuiting, etc., depends upon the exact instant in the cycle at which it may happen to occur (whether near the maximum, or the zero point of the electromotive force wave) the test must be repeated a considerable number of times to insure the maximum condition having been reached. In these tests about ten trials were made at each setting of the gap. To explore the static results in the various tests, gaps were placed to measure the potential between the line-wire and ground, and also across switches at various places, as seemed desirable, and from these, simultaneous readings were taken by as many observers with different settings of the gaps, until a condition was reached where each gap was just ready to spark, but none actually sparked. This ideal condition was not reached in all of the tests. The tests were made on commercial lines, as they stood, with lightning arresters, transformers and the switches used in actual service, and usually with the addition to the circuits merely of the measuring gaps.

The tests reported were conducted at the Provo-Logan plant of the Telluride Power Company, and on the Missouri River Power Company's lines to Butte from Canyon Ferry.

The theory that, strictly as a result of switching operations and arrester discharges where no secondary effects occur, no rise of potential can occur over double that of the exciting potential change is borne out by the experiments. In fact, this rise of potential still excluding secondary effects is usually less than 50 per cent of its maximum theoretical value. However, secondary effects resulting from the static disturbances and modifying the maximum rise must be allowed for. The most common of these is the effect of the sudden excessive momentary current flow, and its results in practically building up the "generator" pressure for the time being. This effect may increase the rise of potential resulting from reflection of charging waves, to double potential in actual experiments.

The effect of static disturbances of any kind to cause in a full-sized plant concentration of potential on the outer portions of windings connected to the circuit is proven clearly. Not that the existence of the *strain* is proved clearly. Severe damage may or may not result. The use of choke-coils in series with the line may or may not protect a transformer coil from the strains according to its power. In the case of an insufficient powerful choke-coil the full value of the pressure change occurring at the line lead may be impressed on a small portion of the transformer winding, the exact proportion affected depending upon the suddenness of the static change. As a matter of experience it is found that serious damage results from local concentration of potential much less frequently than would be expected.

Transformers connected star in primary and secondary with high tension neutral grounded will cause approximately 1.7 times full voltage to ground when a short circuit occurs in such a manner as to affect one leg only of high pressure. This causes 1.7 normal strain on lightning arresters and on all insulation to ground on the legs not short circuited. This extra potential on lightning-arresters is a very troublesome condition to meet; it can be avoided by grounding the neutral point of the generating system. The excessive rise does not occur when two legs are simultaneously grounded.

CONSTANT-CURRENT MERCURY ARC RECTIFIER. BY C. P. STEINMETZ.

The paper opened with a description of the constant-current mercury arc rectifier system as it is used for operating direct-current series arc circuits, from an alternating constant-potential supply. As sketched diagammatically in Fig. 1, it consists of: A constant current

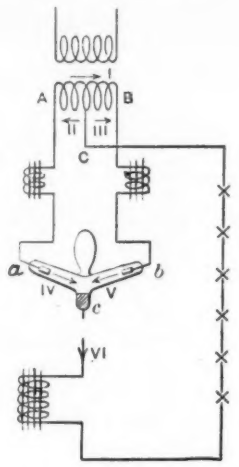


FIG. 1.—DIAGRAM OF RECTIFIER.

transformer, with a tap *C* brought out from the middle of the secondary coil *A B*. A rectifier tube having two graphite anodes *a b*, and a mercury cathode *c*, and usually two auxiliary mercury anodes near the cathode *c* (not shown in diagram Fig. 1), which are used for excitation, mainly in starting, by establishing between the cathode *c* and the two auxiliary mercury anodes, from a small low voltage constant potential transformer, a pair of low current rectifying arcs in the same manner as in the well-known constant potential mercury arc rectifier. Two reactive coils are inserted between the outside terminals of the transformer and rectifier tube, respectively, for the purpose of producing an overlap between the two rectifying arcs, *c a* and *c b*, and thereby the required continuity of the arc stream at *c*. A reactive coil is inserted into the rectified or arc circuit, which connects between transformer neutral *C* and rectifier natural *c*, for the

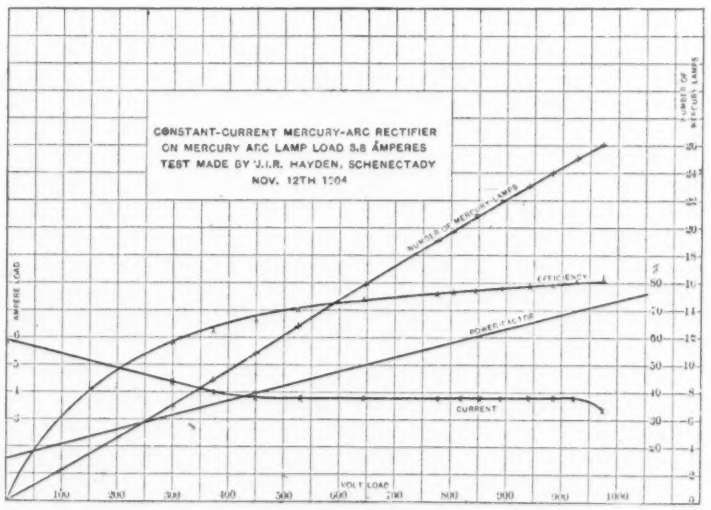


FIG. 2.—RECTIFIER LOAD CURVES.

purpose of reducing the fluctuation of the rectified current to the desired amount.

The rectified or direct-current voltage is somewhat less than one-half of the alternating voltage supplied by the transformer secondary *A B*, the rectified or direct current somewhat more than double the effective alternating current supplied by the transformer.

The efficiency, power factor, regulation, etc., of the mercury arc rectifier system are essentially those of the constant current transformer feeding the rectifier tube. The losses in the system between constant alternating impressed voltage and constant direct current

are: (1) The loss in the transformer which changes from constant alternating potential to constant alternating current. This amounts to 5—10 per cent., according to the size of the transformer. (2) The loss by I^2R and hysteresis, in the reactive coils inserted into the alternating leads of the rectifier, the "alternating reactive coils," and in the reactive coil inserted in the rectified circuit, the "direct current reactive coil." (3) The loss of power in the rectifier tube, which in a series arc circuit is negligible. There occurs a constant drop of voltage, about 18 volts, irrespective of load or current in the tube; the mercury arc voltage. With a 75-light rectifier, at 6,000 volts full load, this loss in the tube is 0.3 per cent. The loss in the reactive coils obviously can be reduced as far as the customer is willing to pay for copper and iron.

A constant-current, mercury-arc rectifier system has been in regular service for over a year, supplying 3.8 amperes constant current to 25 mercury arc lamps, for lighting streets and parks in the neighborhood of the author's residence in Schenectady. The constant-current transformer is a so-called "6-light testing transformer," with the secondary coil wound for two amperes and operating at somewhat higher magnetic density; therefore, the regulation range extends only down to 10 lamps. The record of test of efficiency, power factor, regulation, etc., of this system is given in Fig. 2. In this small unit, of only 3.9 kilowatts output, an efficiency of 80 per cent. and a power factor of 70 per cent is reached, between constant-potential, alternating current received from the primary distributing mains, and constant direct current sent into the arc circuit.

Numerous oscillograms were shown of the voltage and current on both the direct and alternating-current sides of the system. Complete equations are derived for the performance characteristics of the general constant-current rectifier, the author's well-known symbolic method being used.

DATA RELATING TO ELECTRIC CONDUCTORS AND CABLES.

BY H. W. FISHER.

The paper gives some interesting information concerning the use of a steel wire with six copper wires around it for power-transmission circuits suspended in long spans from steel towers. If the wires were laid straight instead of spirally on the steel wire, one would expect to find the impedance only slightly greater than that of an all-copper strand. It appeared also that if two layers of copper wires of the same total cross-sectional area were laid spirally in opposite directions over the same size steel wire, the increased impedance would be reduced, if not entirely counteracted. Although more current would flow in the outside layer of copper wires than in the inside layer, the distance from the steel wire to the former being greater than to the latter, the magnetizing actions of the oppositely flowing currents in the two layers would tend to neutralize each other. A strand with two layers of copper wires thus constructed showed under test that these deductions are correct.

From the fact that copper has a greater coefficient of expansion than steel it was thought that a strand made with a steel center might be subject to stresses that would finally cause it to break. For this reason a test was made upon a 7-wire cable of four copper and two steel wires around a central copper wire. The cable had a conductivity equal to that of 250,000 cir. mils of copper. The results of tests on the last-mentioned cable showed that the impedance is increased to an extent that would probably prohibit the use of such a conductor in practice. However, since the large electrostatic capacity of long aerial conductors tends to produce leading currents, it is thought a conductor of higher impedance might be beneficial in tending to increase the power-factor of the circuit.

Tests made to determine the heat-conducting properties of various insulating compounds seem to show that in order to most freely dissipate heat the cables should be saturated with an oily compound.

A study of the ratio between the effective capacity for alternating currents, and the capacity as measured by the discharge—deflection method—reveals many interesting and useful data. The smaller this ratio becomes the more apt is the dielectric of a cable to become heated under pressure stress. Generally the ratio becomes greater with increased percentages of Para rubber, although this is not always the case. With rubber cables the ratio may be as high as 0.95 and as low as 0.75, at 60 cycles per second, and a temperature 60° F.; it decreases with increase of temperature. For good paper cables the ratio is in the neighborhood of 0.9. For varnished cambric it may vary between 0.75 and 0.50; hence, such cables are liable to become hot under high pressure stress.

With paper cables the variation of capacity with change of temperature is generally the greater the less viscuous the compound. With a certain oily insulating compound the capacity can be expressed by the equation:

$$C = 1.384 + (T - 32)^{1.89},$$

where C is microfarads per mile. T is the temperature on F. scale.

Oily compounds are the best because the cables can be readiest handled in cold weather, and offer the highest resistance strains. Hence, the old idea of demanding high-insulation resistance in megohms per mile, which was best obtained by the use of hard compounds, is incorrect, and the better-informed engineers of to-day either do not mention insulation resistance at all, or else specify 25 to 100 megohms per mile, depending upon the size of the conductor and thickness of insulation.

It is stated to be impossible to lay down any definite rule for the current-carrying capacity of cables; the dampness of manholes and ducts, and the condition and kind of soil and arrangement of cables—all are prominent factors in controlling the temperature rise.

The accompanying table gives the thickness of paper recommended for different working pressures and different half-hour test pressures. In presenting this table the writer wishes it to be clearly understood that there is a large margin of safety in the figures given. There is no doubt that cables with considerably thinner insulation than is recommended would work successfully under normal conditions, but the abnormal conditions which occur occasionally and have been the cause of much damage, not only to cables but accessory apparatus, must be provided for. The extra expense entailed by the addition of a little more insulation is small compared with the much larger factor of safety obtained thereby. For three-phase cables the table gives the thickness of paper between conductors.

THICKNESS OF PAPER INSULATION.

Thickness of insulation, inches.	Working Pressure, volts.	Factory test, 5 minutes, volts.	Installed test, ½ hour, volts.
4/32 to 5/32	1,000 to 1,900	7,000	4,000
5/32 to 6/32	1,900 to 2,250	10,000	6,000
6/32 to 7/32	3,800 to 5,000	13,000	8,000
7/32 to 8/32	3,800 to 5,000	16,000	10,000
8/32 to 10/32	5,000 to 6,500	19,000	12,000
9/32 to 11/32	6,500 to 8,000	22,000	14,000
10/32 to 12/32	8,000 to 9,500	25,000	16,000
11/32 to 13/32	9,500 to 11,000	28,000	18,500
12/32 to 14/32	11,000 to 13,000	31,000	21,000
13/32 to 15/32	13,000 to 15,000	34,000	23,500
14/32 to 16/32	15,000 to 17,000	37,000	26,000
15/32 to 17/32	17,000 to 19,000	40,000	28,500
16/32 to 18/32	19,000 to 21,000	43,000	31,000
17/32 to 19/32	21,000 to 23,000	46,000	33,500

It is difficult to predict at this time the maximum pressures that may be transmitted through cables in the near future. The experienced manufacturer can construct cables that will withstand very high pressure tests at the factory; but without subjecting such cables to pressures operating under working conditions for a long time it is impossible to tell how they will withstand high pressures continually and abnormally high ones occasionally.

METHODS OF MEASUREMENT OF HIGH ELECTRICAL PRESSURE.

BY S. M. KINTER.

The paper briefly summarized the various methods of high-pressure measurement at present employed, pointing out the respective advantages and faults of these methods, and described a new type of Westinghouse static voltmeter.

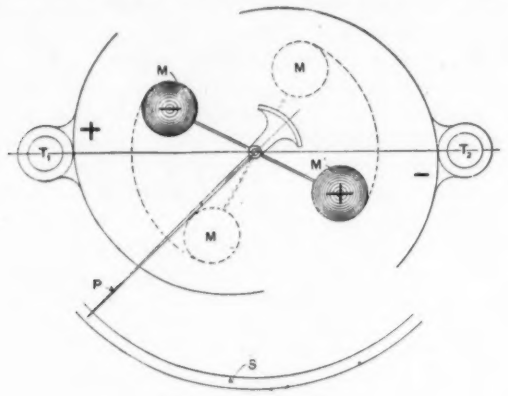
The most important improvement embodied in the new voltmeter consists in the method of its insulation, which is obtained by surrounding the active parts of the meter with a medium of dielectric strength greater than atmospheric air. Such a medium is found in various liquids, and in gases under pressure.

The advantages that result from this method of insulating static meters can be briefly summarized as follows: (*a*) A great reduction in the distance between the operating elements of the meter of different potential, and also between these elements and the case, thus permitting reduction in the size of the instrument. (*b*) A great increase in the actuating forces due to the reduction of distance between active parts. (*c*) A much better form of scale for reading the pressure values is made possible by the reduction of distance between the active parts of the meter. The nearer the moving element is placed to the stationary elements or plates, the better can the shaping of the plates be made to control the form of scale. (*d*) The improved insulation and reduction in size permit the use of a metallic containing case which screens the instrument from external charges. It also makes it possible to operate the instrument on circuits that are grounded without any appreciable variation in its readings from those taken on ungrounded circuits of the same pressure.

The following additional advantages are gained by the use of the liquid insulation: (*e*) It acts as a dampener and renders the instrument nearly dead-beat, thus making it very easy to read. (*f*) Hav-

ing a higher specific inductive capacity than air, it gives a corresponding increase in the actuating forces. (*g*) By properly shaping the moving system, making it hollow, etc., a buoyancy is obtained which relieves the bearings from the weight of the moving element. This greatly assists the restoring force in bringing the system to the proper position of equilibrium for each particular condition.

The improvements above mentioned have been found to exist in the meter which has been developed, one form of which is shown in the accompanying illustration. The operating elements are immersed in a specially treated insulating oil. The terminal plates, T_1, T_2, are so arranged with regard to a moving element, *M*, that an angular deflection of *M*, in a positive direction, tends to shorten the gaps between it and the terminal plates. The induced charges on the two extremities of *M* are of such a nature that they exert forces of attraction on the charges of the terminal plates T_1, T_2, which bring about such a movement. The turning of *M* is restrained by a spring, while the amount of deflection is read on a scale, *S*, by the movement of the pointer *P*. The curve of the plates T_1, T_2, shown in the sketch



STATIC VOLTMETER.

is purely diagrammatic; it is found advantageous in practice to use another form of curve, which gives a very uniform scale over a large part of its range.

Two or more moving elements can be used to advantage for different ranges of pressure; the ones for the higher pressure have less spacing between the cylindrical extremes of the moving elements so as to give them greater gap openings to the plates. The scale cover is all metal, except the glass window through which the scale is read; the cover acts as a screen to prevent external static fields from affecting the pointer. The containing case is of metal, and with it grounded or not the instrument operates equally well.

In calibrating the meter the uniform practice has been followed of first determining the actual neutral position of the moving element with regard to its plates. This is found by trial, pressure being applied and the direction of rotation noted. After determining the neutral position, from which the moving element will deflect in either direction according to which way it is slightly displaced, it is moved through a standard angle in the direction it is finally to deflect upon application of pressure. This practice makes it possible at any time to check the correctness of the angular position of the moving element with regard to the terminal plates, scale, and pointer. Troubles due to attractive forces between the needle and the scale support and cover are avoided by metallically connecting all of them and thus keeping them at the same potential.

One of these meters has been in successful operation for several months in one of the testing departments of the Westinghouse Electric & Manufacturing Company. Its case and insulators were designed for 35,000 volts service, but no difficulty has been experienced in subjecting it to 50,000 volts. It has been tested to 79,000 volts, a suitable barrier being used to prevent a disruptive discharge from terminal to terminal, before a breakdown occurred.

COMMENTS ON REMARKS MADE BY COL. R. E. B. CROMPTON BEFORE THE INTERNATIONAL ELECTRICAL CONGRESS AT ST. LOUIS.

BY JOHN W. HOWELL.

The paper criticises certain remarks made by Col. Crompton at the St. Louis International Electrical Congress, which it is stated, indicate that either the English makes of 220-volt lamps are very much better than those made or known in this country, or that English makes of 110-volt lamps are very much inferior to those made here, or that the considerations and conditions, other than the difference in quality of the two types of lamps, which affect the choice of one system or the other are different in the two countries.

The writer recently secured samples of the best known makes of 220-volt lamps on the English market, thinking that the very extensive use of such lamps there had led to the development of a better lamp those those produced in this country. Photometer tests of these lamps show a very great lack of uniformity in the individual lamps of each make, and a tendency to low candle power and high watts per candle. Comparative life tests made on the English lamps and on six makes of American lamps are stated to indicate that the Edison lamps made in this country are 50 per cent better than the best make of English lamps of this type, and nearly twice as good as the average of the other makes tested.

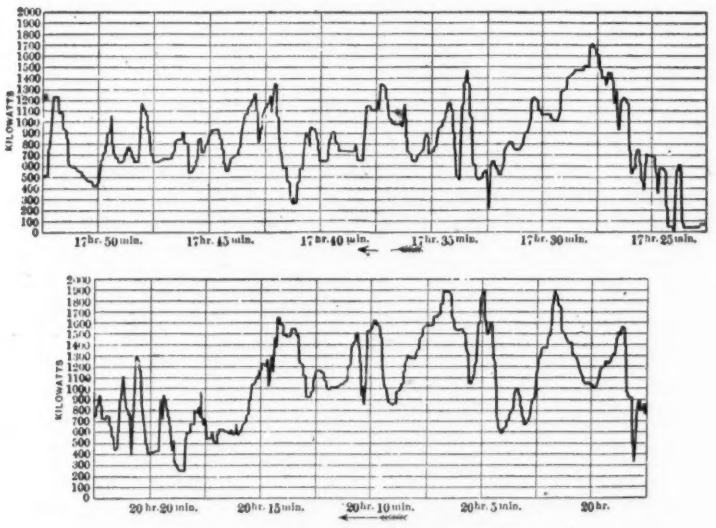
THREE-PHASE TRACTION. BY F. N. WATERMAN.

The paper furnishes a comprehensive comparison of the performance of the direct-current and single-phase systems with that of the three-phase system, as represented by the Ganz system installed on the Italian Valtellina road, and tends to show that, when the equipment of each is considered as a whole, the three-phase equipment possesses characteristics which render it preferable in many cases. Most of the objection that has been raised in this country to the use of three-phase motors for railway purposes finds its origin, directly or indirectly, in the question of the air-gap, the assumption being made that the requirements in this respect as determined by direct current practice are controlling and final. European practice, however, does not support this conclusion. In papers by Mr. de Muralt and Mr. Berg, read before the Institute some years ago, the conclusions reached were adverse to the adoption of three-phase motors for traction. Basing his calculations on the assumption made by Mr. Berg as to service conditions with direct-current motors and comparing them with identical calculations made from the performance curves of three-phase motors having the same depth of air-gap as is employed on the Valtellina line, the author shows that, instead of the alternating current system taking 26 per cent more real power and 22 times as many volt-amperes as the direct-current system, as stated by Mr. Berg, the three-phase system requires only 5 per cent more real power and 32 per cent. more apparent power than the direct-current system, transmission losses being neglected in each case. When proper account is taken of the transmission losses and the initial cost of the installations, it is found that with three-phase motors having small air-gaps there is a reduction of 12 per cent. in first cost, 3.8 per cent. in power consumption, elimination of the attendance and repairs on synchronous converters, and on motor commutators, as compared to the direct-current system, while the disadvantages are that there are three overhead wires to be maintained instead of a third rail and the expense of caring for motor bearings to keep the rotors centered.

In this connection the experience on the Valtellina line is interesting. At the time of the writer's visit, this line had been operating ten motor-cars and two locomotives, having four motors each, for about 18 months in regular service, and for more than a year in more or less regular, although experimental, service. During the entire period three bearings had burned out, two by leakage of water into the oil-reservoirs and one by running dry. In neither case were the motors otherwise injured. No other repairs to bearings had been made. The maximum wear at the end of the first 25,000 miles of regular service, as determined by the repair department, was 0.3 mm., or about one-third the available life of the bearings. The total distance that the car had run was estimated as at least 50,000 miles, thus indicating a life for the bearings of 150,000 miles. The motor-bearings are very large and massive and are provided with ample oil reservoirs. The three-phase motor construction is particularly favorable to ample bearings on account of the large diameter and absence of commutators, the bearings being largely housed within the rotor. Experience on the Valtellina line shows that, so far as main line railways involving considerable distances are concerned, the cost of maintenance of overhead structures is not determined by the amount of actual labor required for repairs, but by the necessity of maintaining a force sufficient for regular patrolling and prompt action in emergencies. The cost of maintaining two overhead wires is therefore not greater than for a single wire under such conditions.

The practical value of the ability to restore energy to the line, possessed by the three-phase system, has been the subject of a considerable amount of discussion, the general conclusion of American engineers apparently being that except for mountain roads with heavy traffic it is an item of comparatively small consequence. Dur-

ing the acceleration period the three-phase motor must run on the rheostat until full speed is reached, and hence, other things being equal, the power input will be greater than with series motors in proportion as this maximum velocity is greater than that at which running on the motor-curves becomes possible. This results in greater rheostat losses. On the other hand, the return of energy in braking is said to be of little consequence because it is small, varying from a small percentage up to about 45 per cent of the stored energy of the train, according to rate of braking. This item will, however, usually be quite comparable in magnitude with the excess rheostatic losses. For certain assumed service conditions it is shown that the rheostatic losses are approximately 6,815 kilowatt seconds with three-phase motors and 3,100 kilowatt-seconds with direct-current motors, but the alternating-current motors return 3,540 kilowatt-seconds in changing from full to half speed on a level track. On roads having grades the return of energy by electrical braking may, as a saving in station equipment and operating expense, be a matter of much importance; it also saves wear and tear on the brake equipment. In spite of the large rheostatic losses during acceleration, the constant-speed characteristic of the induction motor is not without compensating features when the motor is constructed and operated with due consideration of its peculiarities. Constant speed is indeed a positive advantage as regards the maintenance of schedule, and the use of cascade regulation permits of reduction of speed on grades without in the least interfering with the exact preservation of the time-table, since the reduction is by a definite and substantially constant amount. The view usually held in this country is, however, that the three-phase motor is inherently unfit for use on roads having irregular profiles. The experience with the Valtellina road does not appear to sustain this



LOAD CURVES OF VALTELLINA STATION.

opinion, and the constant-speed characteristic seems again to have its own compensating features in a direction hitherto seemingly overlooked by engineers in this country. The Valtellina line is peculiarly irregular in profile, having many very heavy grades, most of which are short, but one is 3.5 miles long. It also has many curves of comparatively short radius. The running speed is 40 miles per hour. The train service is also not dense, so that all the conditions for extreme fluctuation of station load are present. The accompanying curves shows sections of the load curve taken directly from the record of the Olivetti recording wattmeter at the central station during the hours of heaviest load, when four to six trains were running, and while there was some switching being done in one of the yards. The extreme station peaks as shown by the curves are 1.7 to 1.8 times the average load; or, in other words, the ratio of mean to maximum is 0.55 to 0.59 per cent. This remarkable result is due directly to the constant-speed characteristics of the motors; that is, to their dependance upon the frequency. The slip of the motors with trains running at full speed is very small; the energy which they take is determined by this precise relation, being greatly influenced by very small variations of frequency. The sudden application of a heavy load reduces the generator speed, and simultaneously all synchronously running trains drop their loads in a greater or less degree; if the fall in speed is equal to the slip they cease altogether to draw energy. Since the motors usually run with a slip of hardly more than 1 per cent and reach their full output at 2 to 2.5 per cent, a reduction of generation speed of 1 per cent will relieve the station altogether of the load due to synchronously running, trains, while with a greater fall these will momentarily return energy, all trains gradually resuming their loads as their speed falls to proper relation with the generator speed. The trains act like flywheels flexibly connected to the system, and the station peaks are thereby greatly modified.

HEAVY ELECTRIC FREIGHT TRACTION.—BY L. CARL DE MURALT.

The relative advantages presented by the various electric systems available are presented with a view to determine which at the present state of the art is best adapted to handle heavy traction on through lines. The systems considered are: (1) Continuous-current series motors on the locomotives, fed from synchronous-converter sub-stations along the line, which sub-stations receive three-phase, alternating current from the power station. (2) Three-phase, alternating-current induction motors on the locomotives, fed from three-phase transformer sub-stations along the line, which receive three-phase alternating current from the power station. (3) Single-phase, alternating current motors on the locomotives, fed from single-phase transformer sub-stations along the line, which receive either single-phase or polyphase alternating current from the power station. (4) Continuous-current driving motors, fed from motor-generators on the locomotives, the latter receiving single-phase, alternating current from the power station, either direct or through transformer sub-stations along the line.

The first two of these systems were compared in detail for assumed conditions of service, series parallel controlled being employed for the continuous-current motors, and ordinary rheostatic control being used for the three-phase motors. From the calculations it appears that there is not much difference between the two systems as far as actual energy consumed by the motors is concerned. This result is attributed to the fact that, while the continuous-current motors are somewhat more efficient at starting, the energy consumed during the starting period is only a small part of the total energy required for such comparatively long runs, and when running at full speed the alternating-current induction motors have a higher efficiency than the continuous-current motors. Through the employment of cascade control for the three-phase motors, with its corresponding saving during starting and returning of energy during braking, the three-phase motors would probably show up more favorably all the way through. But in any case the difference between the two systems on this account will be extremely small and it will hardly be more than one or two per cent one way or the other. The facts stated above refer to the motors alone, and do not include the supply system. Calculations show that the efficiency of transmission for the continuous-current system is about 68 per cent, while for the three-phase system it is about 88 per cent.

From the accompanying table, which gives a summary for the first cost of the complete installation for the two systems under the conditions assumed, it is seen that the three-phase system has a very great

	Continuous current.	Three-ph. current.
Contact line	$835,692.00	$559,556.00
Sub-stations	552,000.00	48,300.00
Transmission line	679,860.00	679,860.00
Power station	725,000.00	580,000.00
Total	$2,792,552.00	$1,867,716.00

advantage over the continuous-current system as far as first cost of installation is concerned. It is apparent that the cost of operation is also far less for the three-phase system.

The writer expresses the opinion that the single-phase commutator motor, be it of the series, the repulsion or a compromise type, is not at all suitable for heavy traction work, although it possesses over the three-phase motor the advantage of requiring only a single overhead conductor. Due to the fact that the mean value of the torque is only half of the maximum, a single-phase locomotive must have almost twice as much weight on the drivers as either a continuous-current or a three-phase locomotive. The single-phase motor is restricted to a pressure at the commutator of hardly more than 200 volts. It has a lower inherent efficiency, and it will weigh probably 50 per cent more than the corresponding continuous-current motor. It is difficult to design for larger sizes.

The Ward Leonard system furnishes a good solution for heavy low-speed freight traffic, while for a mixed service with both light and heavy trains, and for low as well as high speeds, its advantages are probably not great enough to warrant its adoption in preference to the straight three-phase system.

The writer concludes that of all the systems the three-phase is not only the cheapest to install and to operate, but that the three-phase induction motor also proves itself at least equal in every respect to the continuous-current series motor and superior to it in several rather important points. There remains only one objection to the three-phase system as such, and that is the two overhead wires which it makes necessary. That one wire is simpler to install than two is undoubtedly true. But to judge from this that a double line is impossible, or even only that it will present serious difficulties, is not justified by the actual facts. The successful operation of a good number of three-phase railways proves the feasibility of the two wire overhead line beyond doubt, and it is worthy of note that some of these roads have very complicated switching yards. The construction of the necessary aerial switches has been worked out with such complete success that it is possible to stop a locomotive directly underneath a switch and start it in the same or the opposite direction without any trouble whatever. And these aerial switches are not very complicated either. It must be, of course, admitted that a double line will cost somewhat more for repairs than a single line. Yet it will always be necessary in any electric railway system to have a repair gang ready for emergencies, and these men will be able to look after two wires as well as after one. The difference in cost is thus limited to the difference in cost of material. And it is well to remember that the cost of maintenance of contact lines is very small in any case, compared with the cost of motor repairs. In street railway systems the motor repairs cost anywhere from four to ten times as much as the line repairs. The difference in cost which may be charged against the alternating-current system on this account is therefore a small per cent of an already small item and it is quite certain that this difference will be more than counterbalanced by the greater cost of repairs to continuous-current motors, due to the presence of the commutator which has no counterpart in the three-phase induction motor. The three-phase motor is probably the most robust of electrical machinery extant, and it may well be hoped that it will be used extensively in railroad work in the future.

CHOICE OF MOTORS IN STEAM AND ELECTRIC PRACTICE.
BY WILLIAM M'CLELLAN.

The author discussed certain features characteristic of steam and electric locomotives, and called particular attention to some important points. There is given a large collection of data relating to the steam locomotives used on all of the important roads of the United States and Mexico, which serves to show that there is no standard or demand for standards in locomotive practice.

Looking for standards in electric car motor design meets with little more success than with the design of steam locomotive. The motor, gears, and wheels may be considered as equivalent to the locomotive, since the electrical engineer is concerned only with weight above the trucks. There are many variations in the motor itself for any given type; that is, variations in the armature and field-turns. This will always be more or less necessary. At first sight, it would seem that there is some uniformity in gear-ratios, but the writer has been able to count no less than 48 gear-ratios, varying from one or gearless to 4.78. To form these ratios, 60 different combinations of gear and pinion were used. This entails a stock, of patterns at least, of 40 gears. For a long time 33-in. wheels have been standards for the larger portion of electric cars. With the arrival of the heavy car and rapid accelerations this size has been found too small, and there are now in use wheels of 33, 36, 40, 42, 44, 49 and 62 inches in diameter. It is not likely that many wheels larger than 62 inches will be used, for with the adoption of the gearless motor, if it is successful on the durability test, wheels will be designed strictly with reference to the room for equipment required beneath the car. Even if the future heavy motors are not gearless, the wheels will be as small as possible, in order partly to prevent the lifting of one end of the truck at acceleration and braking.

The standardizing of apparatus arranges itself naturally under two heads: Desirability and Possibility. From the standpoint of desirability there seems to be little room for argument, for in other lines of industry standardization has always reduced the cost of production. Standardization also means greater promptness in delivery of orders; for where parts are odd, either a large stock must be kept or pieces manufactured as they are wanted. Moreover, in the absence of standard parts little stock can be manufactured in advance of sale; that is, for new equipment. The cost of operation has always been greatly reduced by standards. Repairs and replacing of worn out parts are greatly facilitated. The great lack of data, which we all are deploring at present, is of course due to the complexity of the traction problem. Much of this would be removed if motors were made to vary as little as possible. The same motor, with a slightly different gear-ratio, may have much greater heating effect on the same service; and it only renders this problem more complex to have all varieties of ratio unless there is some necessary reason.

There are several reasons why there should be little place for a large number of motors with slight differences. These are: (1) The small amount of information regarding operation of motors *under commercial conditions;* (2) The inability to calculate closely a motor for a given project in spite of the skill shown in speed-time curves and the like; (3) The fact that few or no precautions are taken, or even can be taken, to have the motors operated under the exact conditions by which they were calculated.

In conclusion the author said that it must be conceded that too much conservatism would stifle proper experimenting, and retard real progress. "We must have experimental work, and the more of it the better. But it should be done rationally, that is, with an end in view which is definite. Men in authority should be perfectly sure that demands for changes in standard types are based on accurate information, and not on prejudice, whims and the like. If this position is taken especially as large systems come and increase, there will be no danger of the semi-chaotic condition that exists in some other branches of industry."

ELECTRICAL FEATURES OF BLOCK-SIGNALING. BY L. H. THULLEN.

After giving a brief sketch of the older methods of signaling, the author described the system recently installed on the North Shore Railroad in California, and in the New York Subway. This latter system, which consists of the application of an alternating curent to the track, and the use of a relay that will be operative by alternating current only, is shown in Fig. 1. *A-A* are block sections. *B-B*

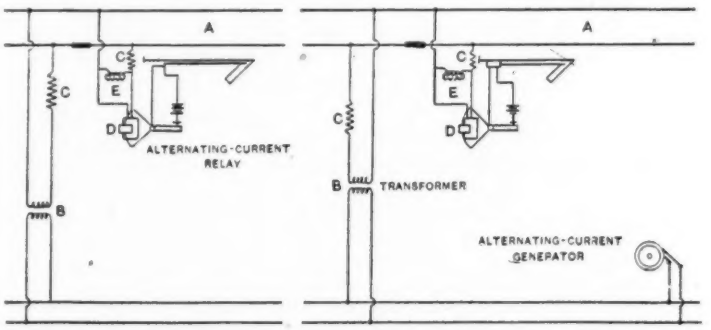


FIG. 1.—SIGNAL CIRCUITS, NEW YORK SUBWAY.

are transformers which transform current from a high pressure 500 to 2000 volts—to about 10 volts for the track circuit. *C-C* are resistances placed between the transformer and track, and relay and track; the former to limit the amount of alternating and direct current flowing through the transformer, the latter to limit the direct current traversing the apparatus at the relay end of the block. *D* is a relay made to operate on the Ferraris principle. *E* is an impedance coil of low ohmic resistance, which offers a free path for the direct current, but is traversed by only a small part of the alternating current.

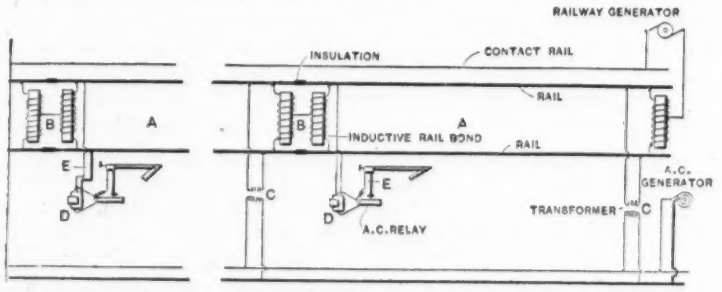


FIG. 2.—IMPROVED SIGNAL SYSTEM.

The impedance coil is, therefore, a shunt to the alternating-current relay; one object of the shunt coil is to limit the direct current that traverses the relay, for the presence of direct current causes the relay to operate in a sluggish manner. As the resistance of the relay is quite high compared to that of the impedance coil, very little of the direct current will traverse the relay.

In the system just described only a small current traverses the sectional rail. Means more recently devised whereby both rails can be utilized to a greater extent for the return current, are shown

in Fig. 2, in which *A-A* are block-sections, from 2000 to 4000 feet in length; *B-B* are inductive rail-bonds of a few turns of copper conductor, of about 1,000,000 cm. cross-section. *C-C* are transformers supplying current to the track, and *D-D* are relays operated by alternating current only, controlling the signals through the local circuit *E*. The transformer is designed to have a large amount of magnetic leakage when the secondary is short circuited by a train in the block, thereby reducing the electromotive force of the secondary and the energy absorbed at that time. The inductive rail-bond is composed of a few turns of bar copper, and adds but small resistance to the track-section; in fact, the actual increase of resistance in a track-section 3000-ft. long, due to the addition of these bonds, is only one-half of one per cent.; or in other words, the efficiency of the track return is 99.5 per cent. The propulsion current traversing each rail divides and traverses the bond in opposite directions, thereby neutralizing the magnetic action of the direct current; while the alternating current traverses the bond in only one direction, making the bond inductive to the track current.

The question naturally arises: Will the resistance of both rails be equal? It is not assumed that they will be, and this is taken care of by making the iron core of the inductive rail-bonds with an open magnetic circuit, the opening being made so large that no excessive unbalancing of the current between the rails will change the inductive effect of the bond. The air gaps may be made sufficiently long to take care of any reasonable amount of direct current, the alternating and direct current traversing the coil being nearly in proportion to the opening in the magnetic circuit. Continuity is attained between adjacent block-sections by connections made to the middle of the inductive windings. It will be seen, therefore, that the track-current from one block cannot extend into another block regardless of the impedance of the bond *B*. The electromotive force at the relay is a little more than one volt. In a block 3000-ft. long there is a pressure of about six volts at the transformer, the difference being due to the high impedance of the rail with the alternating current. The relay is placed at the entrance end of a block and the transformer at the exit end. With no train in a block, the power absorbed by each block is approximately 50 watts. When a train enters the block at the relay end, the power is seldom more than 75 watts, and about 300 watts when the train is exactly opposite the transformer. As the train is exactly opposite the transformer but a few seconds at a time, the actual energy consumed is quite small.

WEIGHT DISTRIBUTION ON ELECTRIC LOCOMOTIVES AS AFFECTED BY MOTOR SUSPENSION AND DRAW-BAR PULL.

BY S. T. DODD.

In a locomotive propelled by electric motors the motor action produces a set of stresses acting between the truck-frame, motor supports and driving-wheels. The horizontal effort at the rail-head resulting from these stresses acts against the resisting forces of the locomotive, the principal items of which may be considered as: (*a*) The rolling friction of the wheels on the track, acting at the rail-head; (*b*) the resistance to acceleration due to inertia of the locomotive, and the resistance due to grades, acting at the center of gravity of the locomotive; (*c*) the air resistance, acting at the exposed surface, particularly at the head end; (*d*) the resistance of the trailing load, acting at the draw-bar.

The effect of the forces here discussed, including the internal or driving forces acting between truck, motor and wheels, and the external or resisting forces, produces a shifting or redistribution of the weight on the various wheels.

Stresses acting on a spring-supported locomotive produce a compression of journal-box springs and a consequent shifting of the center of gravity of the locomotive and a redistribution of the weight on the wheels. A certain amount of redistribution of weight due to this cause may be assumed, but it has been omitted in the following discussion for the reason that it cannot be investigated without a knowledge of the elasticity of the springs.

The resistance due to inertia assumes particular importance in the case of single motor-cars subjected to high acceleration.. The air resistance also is of particular importance in single high-speed motor-cars. In a purely locomotive problem such as considered here—that is, in the case of a motor car used only for drawing trailing loads—the weight of the locomotive is often less than 10 per cent of the weight of the trailing load. The resistances due to the locomotive itself are therefore not as important as those due to the rest of the train, and consequently no great error will be introduced into the results, and their expression can be much simplified by leaving out of consideration the weights and resistances of the locomotive itself and by considering the entire reaction against horizontal effort to be concentrated at the draw-bar.

The author derives formulas for showing the stresses in the various parts of a locomotive and applies these formulas in order to indicate the approximate amount of variation in locomotives as actually constructed. From the calculation it appears that there is an element of uncertainty in the determination of the tractive effort of electric locomotives, on account of the different distribution of weight on the drivers, which seems not to have been very closely considered heretofore.

It appears that in actual cases the reduction in draw-bar pull may amount to anywhere from 6 per cent to 24 per cent of its theoretical value. The author suggests that in the design of electric locomotives it would be advisable to keep in view an arrangement of motor suspension which will give the lowest possible value of the ratio between the increase of weight on any axle and the horizontal effort per driving-axle.

LIMITS OF INJURIOUS SPARKING IN DIRECT-CURRENT COMMUTATION.

BY THORBURN REID.

In a paper presented before the Institute in 1898 the author advanced the hypothesis that the injury done by sparking occurs while the brush is in contact with the segment, the copper of the segment being first melted and then volatilized by the concentration of energy at one or the other of the segment edges. The present paper considers in detail what happens to a commutator segment while it is under the brush.

As the segment comes under the brush it receives a sudden accession of energy both by friction and by current. This energy is developed mainly on the surface of the segment and immediately begins to be conducted away partly down into the body of the segment and partly into that of the brush. When the segment has passed out from under the brush and until it reaches the next brush, energy is both conducted and radiated away from its surface. Thus the surface temperature of the segment oscillates between a maximum just as it leaves the brush and a minimum just before it enters under the next brush.

When the machine has been running long enough at constant load for the temperatures to have reached a stable condition it is evident that the fall of temperature between brushes must equal exactly the rise of temperature while under the brush. As a corollary of this statement, all the heat energy developed on the segment surface while under the brush must have left that surface when it reaches the next brush. Also the curve representing the fall of temperature will be represented by the temperature of the different parts of the commutator surface from one set of brushes to the next while the machine is running under load.

If, therefore, it be possible to take the temperature of the commutator surface at various points between brushes while a machine is running under load, points on this curve will be determined together with the maximum rise of temperature of the segment, while under the brush, and its minimum temperature just before entering under the brush. Sufficient data are not available to determine points on these curves by analysis, but some light can be thrown on the problem by a consideration of the little that is known pending further experiments.

Assigning to the melting point of copper 2,000° F., and taking into account the specific heat of copper and the heat-conducting properties of the material, the author develops equations for showing the conditions under which the copper may be kept below the point of melting and becoming volatilized.

THE DESIGN OF INDUCTION MOTORS. BY COMFORT A. ADAMS.

The paper is an elaboration of a paper on the "Leakage Reactance of Induction Motors," which the writer presented at the last International Electrical Congress. There is given a method for determining the magnetizing current, the effect of the spread of the flux around the teeth and at the end of the core being considered in detail. In determining the leakage reactance account is taken of the slot leakage, the tooth-tip leakage, the coil-end and the belt leakage; the last term refers to the flux which links with equal portions of both the primary and the secondary currents.

The equations deduced are applied to two motors in Hobart's "Electric Motors," of which complete data and test results are closely

checked by the tests. The paper is necessarily mathematical in character, and cannot well be abstracted.

LIMITATIONS IN DIRECT-CURRENT MACHINE DESIGN.

BY SEBASTIAN SENSTIUS.

A system of design is presented, based directly upon general experimental data and the commercial guarantees of the machine, and deals with the limitations imposed upon the development of large machines by the quality of the brushes obtainable, and is intended to assist in the prevention of the introduction of impracticable requirements into specifications relating to direct-current dynamos. The problems are considered under the following heads: (1) Reactance pressure of the single and the double commutator machines; (2) commutators and brush sparking, spitting, glowing and picking up of copper; (3) the design of armatures, with special reference to limiting sizes of direct-current machines.

In discussing troubles at the commutator the writer states that bright, white sparks usually can be traced to a too high reactance pressure. This kind of sparking does not seem to be harmful to the commutator. Glowing of the brushes appears when the armature ampere-turns per pole, and therefore, the armature reaction, exceed a certain limit; this glowing increases with the pole-pitch. The armature reaction may be caused by the working current, and in addition by unbalanced currents going from one brush-stud to other brush-studs of the same polarity. In a particular case the ammeter registered at no-load 300 amperes between brush-studs of the same polarity, whereas the full-load current was but 500 amperes.

Spitting seems to be the combined effect of high reactance pressure and considerable armature reaction. The sparks become yellow or greenish, small explosions (spitting) take place under the brushes, causing carbon particles to escape into the air; the commutator loses its glassy appearance and becomes blackened. The picking up of copper at the contact surface of the brushes has received scant consideration in technical publications. It may take place at full-load, and at no-load, from which one infers that it is independent of the armature reaction. The author has the impression that the effect may result from a steep magnetic fringe produced by a large air-gap; a large electromotive force is generated in the coil under short circuit and an excessive current set up, but not large enough to cause sparking and spitting. Since the generated electromotive force with a brush-lead is a maximum at the end of commutation, both the current and the density reach a maximum near the tip of the brushes, depositing there the largest amount of copper through the agency of the local short-circuit current going from the bars to the forward bush tip (cathode), then to the rear tip (anode) and back to the segments. An easy way to prevent, or at least to minimize this trouble is to adopt a certain maximum contact density for the particular kind of brush employed. It is within the ability of the designer to prevent commutator troubles of the kind described; it can be done by taking conservative values for the reactance pressure, the armature reaction, the current densities at the brush contact, and the peripheral speed of the commutator.

The author states that calculations and observations show that at the point of almost sparkless operation, the spark-pressure will have the following values according to the brushes used, and that the maximum current density should not exceed the limits indicated in order to minimize the picking up of copper:

	Spark. e.m.f. volts.	Maximum density amp. per sq. in.
National graphitized brush	1.6	55
Partridge brush	2.5	35
National Columbia brush	3.2	27
Le Valley Vitæ brush	3.4	25
Dixon pure graphite brush	3.8	22—25

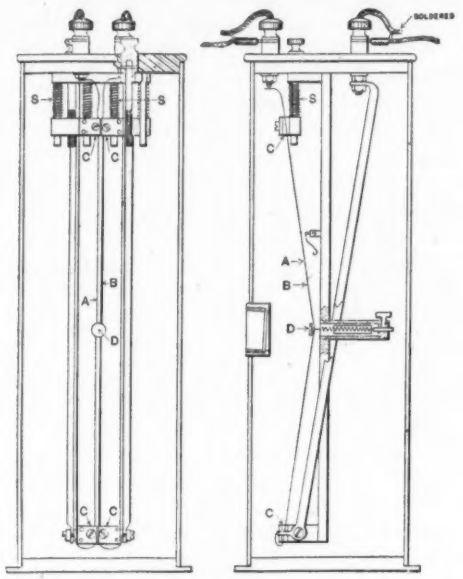
To prevent chattering of the brushes the peripheral speed of the commutator should be kept below 3,600 feet per minute. To insure a well-balanced collection of the current, the length of the commutator bar should not exceed 18 inches. If the above considerations fail to throw light on some commutator troubles, it must be remembered that the mechanical construction of the machine also affects commutation.

A NEW INSTRUMENT FOR THE MEASUREMENT OF ALTERNATING CURRENTS.

BY E. F. NORTHRUP.

The subject of the paper is an instrument designed for easily and accurately calibrating alternating-current ammeters and voltmeters of any capacity. The advantageous features of the instrument are as follows: (a) It is used as a *zero* instrument, and hence calibration is eliminated; (b) it operates with extreme sensitiveness, and being perfectly "dead-beat" is adapted to work with fluctuating currents; (c) it may be used with or without low-resistance shunts; when used with them, it has an unlimited upward range of current measurement, and when used without them, its lower range is down to from two to five milliamperes; as the operation of the instrument depends upon the heating effect of current, it is wholly independent of wave-form and frequency. The constructive features of the instrument are shown in the accompanying illustration.

Two wires, *A B*, of No. 33 hard-drawn silver wire when shunts are used, lie parallel to each other at a distance of 0.158 in., being held near their extremities by ivory clamps, *C C*. Each of the ends of the two wires are connected to binding posts through the medium of



NORTHRUP METER.

heavy leads and soldered joints. One face of a small circular disk of ivory, *D*, rests against the two wires at their middle point, a 0.5-in. circular mirror being fastened to the other face. Fastened at the center of the ivory disk, and half way between the wires, when the disk is in position on the wires, is a small hook. To this, through the medium of a thread, is fastened a small adjustable spiral spring. The small ivory disk maintains its position by friction and the tension of the spring. The wires bend back under the tension of the spring about 0.875 in. from the vertical. The ivory disk does not rest directly upon the wires but bears upon each wire through the medium of a small agate stud shaped like the head of a screw, each wire being in the slot of the agate stud which rests upon it. The two ivory clamps holding the wires near their upper extremity are made separately adjustable in a vertical direction by means of thumb-screws which pass through the hard-rubber top of the instrument. Springs *s s* prevent lost motion when the ivory clamps are screwed up or down.

The arrangement of parts above described is supported by a brass frame and a circular hard-rubber top. This frame drops into a circular nickel-plated brass case. The case has a window in it directly in front of the mirror on the small ivory disk.

If any elongation occurs in the wire to the right, the side of the mirror will be drawn back by the spring, and a deflection to the right is obtained. If, however, an exactly equal elongation occurs in both wires at the same time, the plane of the mirror will not tilt, but simply move back, keeping parallel to itself. If the mirror is observed with a telescope and scale, say at a distance of one meter, very minute angular deflections of the mirror will be easily observed, while a sinking back of the plane of the mirror away from the scale will not be observable.

Now if an alternating current of unknown strength be sent through the wire *A*, the wire will elongate, deflecting the mirror toward the left. Pass an adjustable direct current, which can be measured, through the wire *B*, until the deflection is reversed and brought back to zero on the scale. If when the deflection is zero, and certain precautions which were outlined, have been observed, the strength of the direct current is known, the strength of the alternating current will also be known; for it is exactly equal to the direct current. This, however, is on the assumption that equal currents through the wires *A* and *B* produce equal elongations of the wires. Previously to comparing the currents, connect the wires *A* and *B* in series, and send a current through the circuit; if under these conditions the mirror be not deflected at all, or only slightly, it proves that the two wires are practically equally elongated by the same current strength. The limit of this possible small deflection may be taken as the true zero

of the instrument. If this zero is maintained under working conditions, it means that the strength of the alternating current in the wire *A* is equal to the strength of the adjustable and measured direct current in the wire *B*.

By means of shunts the instrument will measure currents of unlimited value. It should be easy to obtain with the aid of this instrument an accurate measurement of the currents of a high frequency coil, or of the high-frequency currents now being used for many experimental purposes, that are produced either by special high-frequency dynamos, or by interrupted electric arcs. The instrument has the following useful features: It is inexpensive as compared with a Kelvin balance or with the Siemens electrodynamometer, which, when constructed for measuring large currents, is very costly to make and to calibrate. It is simple and easy to understand and manipulate. It is not delicate, and is uninfluenced by the proximity of iron or other ordinarily disturbing influences. Unless very accurate results are required it is easy to substitute a pointer for the mirror, and thus make the instrument portable. It is not affected by ordinary mechanical vibrations. If any injury happens to the working wires, they can be quickly replaced.

EDDY CURRENTS IN LARGE SLOT-WOUND CONDUCTORS.
BY A. B. FIELD.

The paper discusses the more important causes of eddy currents in heavy conductors carrying alternating currents and surrounded on three sides by iron. The eddy currents are produced by flux crossing the slot transversely from tooth through the body of the conductor, where they take an elongated form, tending to follow along the top edge of the conductor throughout the length of the core and return along the edge nearer the slot-root. The eddy currents themselves will produce magnetic flux which will react upon the whole system of currents, and the net result in the conductor will be a current varying in density and phase at different depths. The density of transverse flux at any depth is practically determined by the slot-width and total current in the slot below the transverse path considered; and that generally the tooth saturation, even when carried high up, will have quite an insignificant effect. This is due in large measure to the fact that the flux, which is responsible for the saturation of the teeth, passes down both teeth in the same direction. Under actual working conditions the transverse flux will combine with the main flux in an obvious way, but the above considerations will still stand.

It is pointed out that within the limits of practical accuracy the density of transverse flux depends only on the width of slot and the total number of ampere-conductors behind the point considered, and hence it is possible to construct curves for solid conductors, giving the I^2R factor in terms of an extremely simple quantity involving only the frequency, depth of conductor, and the ratio of total net copper thickness measured across the slot to the slot width, a quantity which may be calculated for any case in a few seconds. It is further shown that the same curves, with a slightly different interpretation, are immediately applicable to various other windings in every-day use, in which the eddy currents discussed take the form of cross currents between the strands of a stranded conductor.

It is stated that a twisted conductor, in a single-layer winding, has the same I^2R factor as an untwisted one of half the depth; but this halving of the effective depth will generally be found in practical cases to reduce the eddy losses from a very serious quantity to entirely negligible dimensions. For the second and successive layers of a multiple-layer arrangement the twisted or pressed stranded conductor is very much better than an untwisted one of half the depth. In many practical cases of two-layer windings using a pressed stranded conductor, it will be found satisfactory to leave the lower conductor solid, the losses in this layer being comparatively slight, even when excessive in the top layer.

In the case of a bar winding two conductors deep, some improvement is achieved by using a laminated conductor, the losses being diminished and distributed over the end connections as well as the active length. A still greater improvement results if the stranding is continued between the top and bottom layers, or better still if the conductor be twisted over between these layers. This last case would generally be used, rather than the previous one, and corresponds to a half-formed bar winding; it is unnecessary (from the point of view of the present discussion) to keep the strands insulated farther than throughout the complete turn length; i. e., the connecting clip may join conductors together, all strands at once.

WATER-POWERS OF THE SOUTHEASTERN APPALACHIAN REGION.
BY F. A. C. PERRINE.

The paper furnishes a general survey of the water-powers in the principal rivers of the Southeastern Appalachians. The nature of the flow of water with respect to regularity is discussed in connection with each river mentioned. The author states that already the development of a few of the available sites has had a powerful influence on the commercial life of the South, and in the contest for industrial supremacy which is continually being waged between sections of our country the ready availability of water-power in the South is certain to play no unimportant part. The conditions, it must be observed, are in all respects different from the conditions in other sections of the country. There is no location which can command the field, and within a comparatively short distance of each plant there is another location which may be developed and probably offer competition. The minimum flow is everywhere small and the floods heavy, varying from 75 to 150 times the minimum. But, on the other hand, there are at hand a class of manufacturers who appreciate the value of water-power even when it is variable, and are accustomed to providing themselves with steam auxiliaries for allowing the use of surplus water-power. These conditions are, on the whole, favorable to the development of water-power on a large scale, but point to the necessity for effective management and a comprehensive plan for the development of a section of territory rather than of a single plant.

THE DEVELOPMENT OF THE ONTARIO POWER COMPANY.
BY P. N. NUNN.

The paper gives a description of the hydraulic and electrical features of one of the later developments at Niagara Falls, where 200,000 hp will be utilized. The generators are of conventional horizontal-shaft type, three-phase, 25-cycle, and deliver 12,000 volts at 187.5 r.p.m. The turbines are of Francis or inward-flow type, double, central-discharge or balanced twin turbines designed to deliver 12,000 hp under 175-ft. head. Their shafts are 24-in. maximum diameter, and each carries two 78-in. cast-steel runners of "normal" reaction. Although entirely feasible to use the vertical-shaft turbine, and although restricted space at the power-house requires greatest floor economy, nevertheless horizontal units are employed on account of their freedom from step-bearings, their higher efficiency and their greater accessibility.

The features of particular interest are found in the intake, the symmetry of arrangement, centralization of control and almost perfect isolation of apparatus. The enormous volumes, both of water and of power, involved not only in the individual units but also in the aggregate, have presented new problems heretofore unprovided for in standard sizes of apparatus, thus necessitating the development of larger capacities and the creation of new types.

NOTE ON A SIMPLE DEVICE FOR FINDING THE SLIP OF AN INDUCTION MOTOR. BY CHARLES A. PERKINS.

The device consists of a strip of sheet iron, clamped at one end to an iron base, leaving the other end free to vibrate. An electromagnet is mounted on the same base with its pole near the free part of the strip. When an alternating current is passed through the electromagnet, in series with one or more lamps, the strip will be thrown into vibration, if it has about the same period of vibration as the driving current. The adjustment of the time of vibration of the strip is readily made by giving it such a length as shall cause it to vibrate a little too rapidly and then loading it by a small copper wire which may be slid along the strip until approximate synchronism is obtained.

On the shaft of the motor is placed a cardboard disc, pierced by as many equally spaced holes as there are north poles on the motor. The iron strip, with the electromagnet, is now placed in a good light and set into vibration by the supply current and viewed through the holes in the rotating disc. If the hole comes at each revolution in front of the eye when the current is in a certain phase, the vibrating strip will also be in the same phase at each view and will apparently be standing still. As the motor slips backward, the strip is seen at successively later phases of its vibration, and seems to be slowly vibrating, making one complete vibration when the motor has lost one complete cycle. By this method the slip may be counted up to about 300 cycles per minute, serving for all cases excepting for small motors with heavy loads or on high-frequency currents.

A NEW CARBON FILAMENT. BY JOHN W. HOWELL.

The author, in opening his paper, said that the new carbon filament which forms its subject has characteristics so differing from those of any previously known filament as to seem to indicate that it is a new form of carbon. Besides being very interesting on account of its physical characteristics, the filament is of considerable value on account of its much better life or efficiency, as compared with the carbon filaments heretofore known. The new characteristics of the filament may be said to be due to the *proper* application of excessively high temperatures to the ordinary carbon filament. The value of the product is determined by the conditions under which the high temperatures are applied.

It is well known that an ordinary incandescent filament in an evacuated lamp may be heated to excessive temperatures by the application of high current without producing any beneficial change in the filament. To produce the effects described in the paper, the heat is externally applied to treated filaments at atmospheric pressures. The simple application of the highest attainable temperatures to the plain carbonized cellulose fibre, i. e., the so-called "filament base," is also incapable of producing any considerable change in the filament. This high temperature treatment of the base is, however, a beneficial step in the process described.

In attempting to graphitize carbon filaments it was discovered that treated filaments undergo very remarkable changes when subjected to the highest possible temperature of an electric resistance furnace. The furnace consisted of a carbon tube, held at the ends by large water-cooled copper clamps; the tube was imbedded in powdered carbon to prevent its combustion. The filaments were packed in small, cylindrical carbon boxes, which were fed into the heated tube. The temperature was usually between 3,000° and 3,700° C.

Under such firing the ordinary treated filament changes in appearance; its graphite coating looks as though it had been melted, and its specific resistance is greatly reduced. The resistance of one of these filaments, measured at ordinary temperature, may be reduced as much as 80 per cent by the firing.

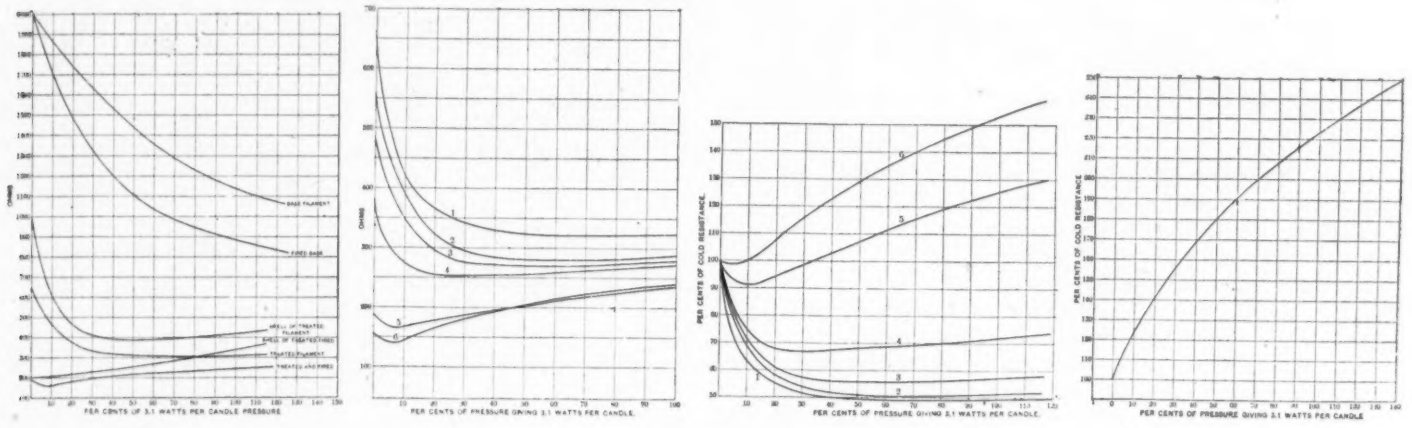
Fig. 1 shows curves of resistance and temperature of a regular base filament, a base filament fired, a regular treated filament, a treated filament fired, a shell of regular treated filament, and a fired shell. The resistance in ohms is plotted against the temperature, as indicated by the percentage relation of the pressure on the filament to the normal pressure at which the filament has a consumption of 3.1 watts per candle.

The curves show a more rapid fall in resistance of the base filament after firing, but little change in the character of the curve. The change produced in the treated shell by firing is very great, the cold resistance being reduced from 1,000 to 200 ohms, while the great change in the character of the curve of the fired shell brings the hot resistance of the two shells nearly together. The resistance curve of a fire-treated filament depends upon the relative thicknesses of base and coating and upon the temperature of firing. Figs. 2 and 3 show curves of filaments fired at five different temperatures and of a similar filament that has not been fired. In Fig. 3 the resistances are shown in percentages of the cold resistances, and in Fig. 2 the actual resistances are shown.

These filaments were heated in the carbon tube resistance furnace. They were enclosed in a cylindrical carbon box, placed inside the tube, one end of which was left open for observation. An indication of the temperature was obtained by looking directly into the open end of the tube at the box holding the filaments, and holding in the line of vision the filament of an ordinary 50-volt lamp, the temperature of which was adjusted until the filament became invisible against the incandescent carbon box. The pressure on the lamp was then observed and the box of filaments taken out.

Curve No. 1 is the resistance curve of a regular treated filament. Curve No. 2 is the curve of a similar filament heated in the tube to a temperature corresponding to the temperature of a carbon filament operating at 153 per cent of its normal pressure, or at 125 candles for a normally 16-cp lamp.

Curve No. 3 is the curve of a filament fired at a temperature corresponding to the temperature of a lamp at 161 per cent of its normal pressure, or at 163 candles. Curve No. 4, 183 per cent of normal pressure, or at 230 candles. Curve No. 3, 200 per cent of normal pressure, or at 280 candles, for a 16-cp lamp. Curve No. 6 is the curve of a filament heated hotter than No. 5. The temperature was not measured by this method for fear of breaking the comparison lamp.



FIGS. 1, 2, 3 AND 4.

An attempt was made to measure the temperatures by means of an optical pyrometer (Wanner) which indicated temperatures up to 3,700° C. at the highest heats.

Fig. 4 shows the resistance curve of a filament made from a thin base having quite a thick treatment; this shows a resistance increasing to 250 per cent of its cold resistance.

The change in the resistance curve of this coating from negative to positive seems to be due, in part at least, to the action upon the shell of some substance driven out of the base filament by the high temperature. This is indicated by the considerable change in the curve of a treated fired filament produced by heating the base filament to the same high temperature before it was treated and then reheated.

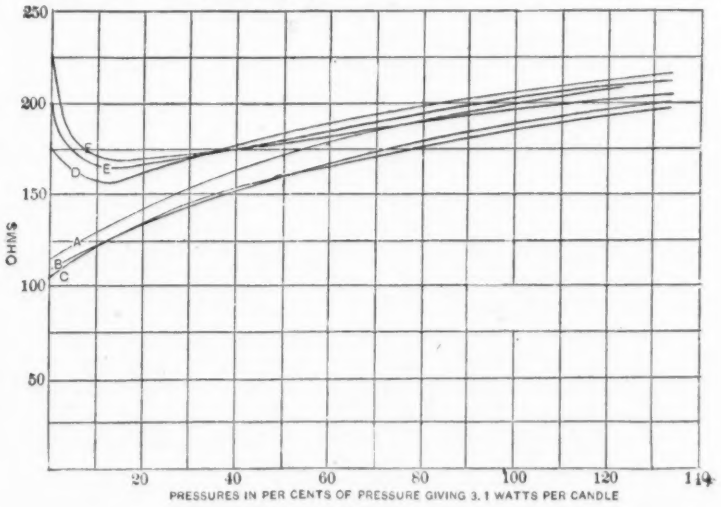


FIG. 5.

Fig. 5 shows resistance curves of carbons fired at the same temperature after treating, but with the base fired at different temperatures before treating. The base filament in curve *A* was unfired; in *B*, *C*, *D* and *E* the base was fired at successively higher temperatures.

It will be observed that the curves made from filaments, the bases of which have been heated to high temperatures before being treated, are much less positive than the others. The conclusion that the effect is produced by material being driven out of the base seems to be borne out by the fact that during the preliminary heating of the base at high temperatures it loses practically all of its mineral ash constituents, and also by the fact that, if some of the elements that the base loses in its high heating be separately placed in the furnace with the treated filaments, effects are produced similar to those observed when the base has not been previously heated.

The effect of some agency besides heat is also indicated by the fact that the lamp filament used in the temperature observations, although maintained at the same temperature as the filaments in the furnace, and for a sufficiently long time, showed no indications of such a change as was produced in the filaments in the furnace.

The appearance of a filament fired both before and after treating is very different from that of one fired after treating only. The former has a slightly pebbled appearance, as seen through a microscope, and a rather dull-gray color.

The single-fired treated filament is generally very much blistered, many blisters extending outward a distance greater than the diameter of the filament. These blisters indicate an outflow of gas from the base when the shell was in a soft condition. The surface of the filaments is highly lustrous.

The specific resistance of the highly heated coating has been found to be as low as 0.00006 ohms per cubic centimeter, which is very much lower than the specific resistance of any other known form of carbon or graphite. Its specific gravity is also much higher than it was before heating.

Its changed nature is also indicated by its toughness and flexibility. The coating of a double-fired filament may be pulled off in short tubular sections, which if pressed flat, will spring back to their original form when the pressure is removed. The same coating before beginning firing is comparatively brittle, and will break with very little pressure. On account of the positive resistance curve and physical characteristics of these filaments, they have been given the name "metallized filaments."

The treated coating on filaments, even before firing, is graphite, as determined by the chemical test established by Berthelot—the production of graphite acid (a yellow insoluble substance) when treated with a mixture of anhydrous nitric acid and potassium chlorate. Ordinary carbon is dissolved by these reagents. The coating on the treated filament has also the greasy feel of graphite, and gives the characteristic mark of graphite on white paper.

After being heated to high temperatures in the electric resistance furnace these characteristics continue and the chemical action is much more marked.

Metallized filaments blacken the lamp bulb very much less than ordinary filaments. This may be due to the removal from the former of practically all the mineral ash and other impurities, or it may be due to the changed character of the carbon itself.

Bamboo, coated by dipping in a solution of asphalt, is altered by firing, the coating changing to graphite and giving the characteristic positive curve.

Silk dipped in a sugar solution also gives the same result.

The base of a metallized filament, from which the treated coating has been removed, when mounted in a lamp has been found to give the resistance curve of a fired base. Pieces of the coating, about 1.5 in. long, mounted in lamps, have been found to give the strongly positive resistance curve that is characteristic of the metallized filament. These observations show that the change is practically all in the treated coating and not in the base.

Metallized filaments, as above described, are much more stable at high temperatures than ordinary carbon filaments.

The most effective carbon filament lamp now in general use operates at 3.1 watts per candle and under accurate test conditions gives a useful life (to 80 per cent of its initial candle-power) of about 500 hours. At the present time metallized filaments that give the same useful life at about 2.5 watts per candle are being produced with a fair degree of uniformity.

SYNCHRONOUS CONVERTERS AND MOTOR-GENERATORS.
BY W. L. WATERS.

After giving the standard ratings of synchronous converters and of motor-generators and showing the cost, efficiency and necessary floor space of each, the author discusses the relative advantages of the two types of machines.

A synchronous converter is more liable to hunt and to flash over, and is a somewhat more complicated piece of apparatus than a motor-generator set. On the other hand, a synchronous motor wound for a pressure of over 6,600 volts is not so reliable as a transformer wound for the same pressure. Generally speaking, from the point of view of reliability of operation, there is little choice between 25-cycle converters and 25-cycle motor-generators, although in a 60-cycle installation the advantage is decidedly in favor of the motor-generator. Motor-generators have another advantage over synchronous converters in that the former are not so liable to hunt as the latter. From the operating engineer's standpoint, a motor-generator is preferable to a synchronous converter in almost every respect except as to efficiency and cost, and even as to cost a motor-generator is decidedly the cheaper for low voltages and large outputs.

Speaking generally from the designer's standpoint, there is not much to choose between the difficulty of designing a synchronous converter and that of designing a direct-current generator of the same output, speed and voltage. The copper loss in the armature of a polyphase synchronous converter is usually considerably less than in the case of the corresponding direct-current generator, so that such converters are sometimes designed with a much smaller cross-section of copper than would be used in a generator. This is bad practice. The copper loss in a synchronous converter armature is not equally distributed, the loss in the bars nearest the collector leads being usually much greater than in those midway between the leads. As regard heating, six-phase synchronous converters have a slight advantage over two or three-phase converters. But six-phase machines call for such extra complications in the cables and switchboard that they are seldom employed.

An important feature in the design of the armature of a synchronous converter is often overlooked, and that is equality or balancing of the phases. If the windings of the different phases on a converter armature are not all exactly equal and not all placed on the armature in an exactly similar and symmetrical position with regard to one another, then the phases will be unbalanced, with the result that the load will not be balanced among the phases and that there will be a greater tendency to hunting. If the three ammeters in the three phases of such a rotary are watched the load can be seen changing from one phase to another. This is the reason why synchronous converters with series wound armatures are usually unsatisfactory.

The author states that the paper has not been written with the idea of advocating the use of synchronous converters instead of motor-generators, or vice versa, but more with the idea of comparing them generally, their advantages and disadvantages, and of pointing out some of the characteristic features of each machine. The question as to which type of machine ought to be used in any given case can only be decided after every feature of the situation has been duly considered. Broadly speaking, however, the tendency to-day is toward motor-generator sets in lighting systems and synchronous converters on traction systems. This seems to be perhaps the most rational conclusion. .

INDUCTION ALTERNATORS. BY WM. STANLEY, ASSISTED BY G. FACCIOLI.

The paper describes a new form of alternators, the fields of which are energized by alternating instead of direct current. The alternators have their rotors and stators wound with distributed windings. The rotor circuits are supplied with very low frequency polyphase currents. These currents produce a field, or fields, which move around the rotor at a speed proportional to the frequency of the magnetizing or exciting source. If the connection of the multiphase exciter circuits is such as to produce a clockwise electromagnetic rotation of the field (rotor), the rotor structure of the alternator may then be mechanically revolved either in the same or in an opposite direction. The currents in the stator produce a field in the air-gap of the machine and this field revolves synchronously with the rotor induction, *but not* synchronously with the rotor conductors, for they (the conductors) are going faster (or slower). They are, therefore, *constantly overtaking* the stator-produced field, and *passing through* it. That is to say, cutting it, and they, therefore, have electromotive force induced in them of the exciting frequency; the final result being that an electromotive force of the same frequency as that of the exciting current is produced in the rotor (field) conductors, by simply loading the alternator in the usual manner.

This "stator induced electromotive force" in the rotor conductors is evidently proportional to, and in quadrature with, the stator

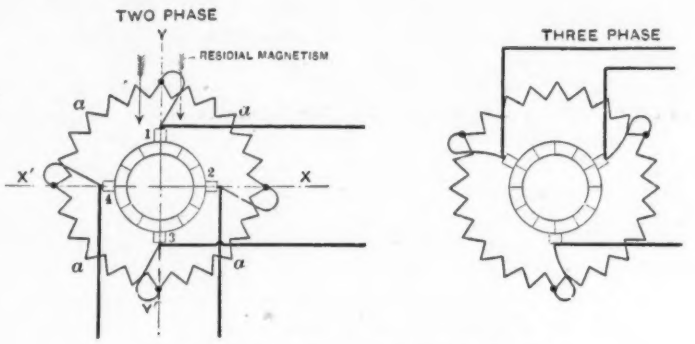
current. It is zero when the stator current is maximum, maximum when the stator current is zero, etc. It is of the utmost importance in the phenomena, for if the rotor circuit be of low resistance (great time constant) the "stator induced electromotive force" in the rotor will produce a current (called "stator induced current") approximately *equal* in value, nearly *opposite in phase* to the stator current and, consequently, competent to neutralize the magnetomotive force of the armature or stator circuit and to destroy almost completely the magnetization due to the stator winding. In such an alternator there should be, then, no armature reaction, no back magnetization, no distortion of the field of the machine.

When the generated frequency of the machine is equal to the difference of the frequency of rotation and the frequency of excitation, the magnetization of the machine may be higher when loaded with non-inductive load than when running free. On the other hand, the resistance of the rotor when the generated frequency is equal to the sum of the frequency of rotation and the frequency of excitation, has the effect of decreasing the magnetization of the machine when loaded with non-inductive load. If the rotor of the machine had zero resistance and perfect mutual induction, then the rotor current would lag exactly 90° from its electromotive force in both cases, and would be exactly equal and opposite to the stator current. There would be no resultant magnetomotive force due to the load, and therefore the machine would have constant electromotive force at any load and at any power factor. It then appears that if a machine of this type, that is, a machine with almost perfect mutual induction and very low resistance, could be built, there would be very little difference in its regulation when excited by forward and backward running fields. The principal difference would consist in the fact that with a forward-running excitation the exciter would supply energy to the alternator in proportion to the ratio of the exciting to the generated frequency, while with the backward-running excitation, the exciter delivers no energy to the alternator, but receives energy from it.

In order to make the exciter self-exciting and self-contained, and to reduce the apparatus to the simplest terms, there has been devised the scheme for excitation shown in the accompanying illustration. It is to be noted that the usual method of self-exciting a machine of the continuous-current type is to connect the armature terminals; that is, the brushes collecting currents from the armature, to a field coil so located with reference to these brushes that currents in the coil will increase the electromotive force and current the brushes deliver; thus a cumulative action between armature and field coils continues (in ordinary practice) until limited by the saturation of the iron in the machine. In the machine here described a pair of brushes corresponding to those of an ordinary generator is connected to a field coil, so located with reference to these brushes that the flux it produces will be displaced by a predetermined angle, dependent upon the number of phases desired. Thus for a two-phase machine a pair of brushes is connected to a field coil so located as to produce a flux, by means of which and by rotation, an electromotive force is generated upon the *other* pair of brushes, while the second pair of brushes is connected to a coil so located as to produce a flux that will generate an electromotive force on the first pair of brushes. This is shown in the cut, which illustrates the connection and operation of self-excitation by means of two and three-phase currents.

Let the residual magnetism of the machine be as shown in the diagram. Then, on rotating the armature, an electromotive force will be developed on brushes 2-4. These brushes are connected to the field winding at X-X^1 instead of at Y-Y^1, as is usual in exciting continuous-current machines, consequently a current will flow, say, from X through a-a to X^1, producing a flux through the armature at 90° to the residual magnetism. A resultant field will, therefore, lie between the points Y-X and Y^1-X^1, but this field will generate an electromotive force on brushes 1-3 and these brushes will deliver a current through Y-a-a-Y^1 in such a direction as first to *oppose* the residual magnetism and afterward reverse its direction. At the instant that the residual magnetism is zero the only field operating in the machine is that due to the currents from the brushes 2-4; subsequently this field combines with the vertical reversed field to brushes Y-Y^1, producing a resultant with polar line between X-Y^1. These operations being cyclic, they recur at periodic intervals, and the phenomena become continuous. As the resistance of the energizing circuit a-a is low in comparison with its inductance the currents delivered from each pair of brushes lag nearly 90° behind the electromotive forces, and therefore little energy is wasted in field excitation.

This type of machine produces low-frequency, polyphase currents at normal speeds, and delivers zero and negative power factor currents at a constant or rising potential with much greater exactness than the ordinary type of alternator; for the reason that the armature reaction of a machine of this type may be made practically zero, because the field of the machine progresses in the same direction as the rotation of the armature and consequently tends to maintain



STANLEY SELF-EXCITING GENERATOR.

the electromotive force at low power factor loads, and because it may be compensated to give a positive, potential gradient.

The writer stated his intention to describe later the application of the phenomena here outlined to various new types of alternators, and expressed the opinion that machines excited by continuous currents cannot compete with those employing alternating-current excitation, as the latter possess distinct advantages in simplicity, performance and cost.

NOTES ON THE POWER-FACTOR OF THE ALTERNATING-CURRENT ARC.

BY GEO. D. SHEPARDSON.

The paper reports the results of a series of experiments made upon a standard arc lamp. Study of the power factor of the arc under varying conditions shows that it is practically independent of the form of the electromotive force applied to the lamp terminals. The power-factor of the enclosed arc with soft-cored carbons is found to be practically constant for current strengths between 4.5 and 8.5 amperes with 7/16-in. carbons, varying between 95 and 99 per cent. With the same grade of soft-cored carbons and with open arc, the power-factor of the arc increases from 94 per cent with 5.5 amperes to 99 per cent with 8.5 amperes, being independent of wave-form of impressed electromotive force, at least within the limits of accuracy available. With open arc and with copper-plated hard carbons, such as commonly used with open arcs, the power-factor of the arc varies from 80 to 90 per cent.

The power-factor of the arc is found to remain constant when the arc pressure is constant, whatever the range of current and whatever the wave-form of impressed electromotive force. Likewise when the length of the arc (measured by the image thrown by a lens) is maintained constant, the power-factor of the arc is independent of changes in current and in wave-form of electromotive force applied to the lamp terminals. The quality of the carbons and the exposure of the arc to the air affect the power-factor of the arc considerably. The distortion of the current wave-form doubtless affects the wave-form of electromotive force developed by the transformer or by a small generator. The effect of the lamp coils doubtless tends to make all impressed electromotive force waves alike when they reach the arc. Future investigations are expected to determine the wave-form of electromotive force actually applied to the arc under varying circumstances, the effect of changing it and the reactions of the arc upon the source of electromotive force.

The hard carbons show a much more sudden rise in the difference of potential around the arc than do the soft carbons. Characteristic of the soft cored carbons is the secondary peak on the arc potential curve, occuring nearly simultaneously with the maximum current value and thereby raising the power-factor. The more gradual growth of the current wave with the long arc will be noted, probably being due to the more rapid cooling of the arc gas during the extinction. With long arcs there is a tendency toward a double peak on the front of the potential wave. With the short arc the potential wave rises to a marked peak at the rear.

LETTER TO THE EDITORS.

Engineering English.

To the Editors of Electrical World and Engineer:

SIRS:—The statements from the London *Electrician*, relative to the abuse of the term "wattmeter," which you quote on page 1121 of your issue for June 17, are well worthy of serious consideration. The writer wishes to call attention to a few of the numerous other terms which are similarly misused.

In electrical literature the statement "current is sold at x cents per unit" is found so frequently that it excites no comment, yet the error embodied in the statement is equally as great as would be the case were it to read "electromotive force is sold at x cents per unit." It will be appreciated that even the term "power" is inadequate in this connection, because the unit is a kw-hour or a hp-hour and necessitates the use of the factor time in connection with power; the real quantity sold is "energy," now *power*.

If one were to state that the "efficiency of a generator is x hp per watt," he would be severely criticised. The statement that a lamp has an "efficiency of x watts per candle" is certainly open to the same criticism. The fact that there are available no reliable data upon which to base the real efficiency of the various illuminants seems a poor excuse for the misuse of the term "efficiency."

Chicago, Ill. J. L. THORNE.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Transformer Insulation.—MOORE.—Insulation has a double purpose: it must not allow the current "to break through it nor to steal through it." For the first purpose the dielectric strength must be high, for the second the ohmic resistance must be high. For telephony and telegraphy, where the voltages are low, the dielectric strength is of relative'y small importance, but high ohmic resistance is needed. On the other hand, for the generation and transmission of energy, dielectric strength is the property mainly desired, as the leakage of a small amount of current is not objectionable. For transformer insulation, it is necessary to insulate the electric circuits so that the transformer will operate without breaking down under all reasonable conditions of service. A very high ohmic resistance is not a measure of the reliability of the transformer against breakdowns. The ohmic resistance tests of insulation is of relative value only. The same readings may be obtained twice from the same apparatus under entirely different conditions of real dielectric or volt-resisting value. There is no direct relation between the breaking down e.m.f. and the ohmic resistance. However, a low ohmic resistance usually means a low breakdown test, but a low breakdown test does not necessarily mean a low ohmic resistance. The principal use of ohmic resistance measurements of insulation lies in the comparison they afford of the damp-proof qualities of various dielectrics and in the measure of the degree of dryness attained in drying out a piece of electrical apparatus. Several curves are given from the actual tests on certain untreated insulating materials and transformers which were exposed to moisture. The following general

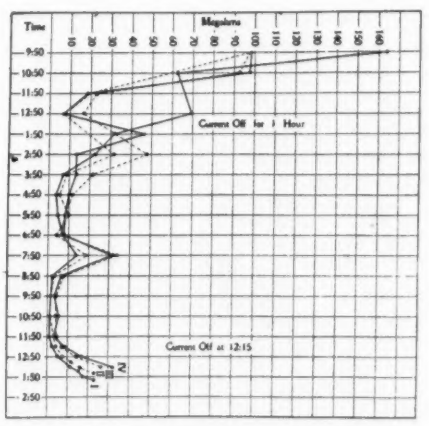


FIG. I.—CURVES OF OHMIC RESISTANCE OF INSULATION.

points are brought out in these curves: The ohmic resistance and dielectric strength of moist insulation are higher when cold than when hot. In expelling the moisture from a transformer it is bound to accumulate more or less in certain parts owing to the complex structure of the transformer, thereby causing the ohmic resistance to vary considerably until such an amount is expelled that the remaining moisture passes out at a diminishing rate, when the ohmic resistance will begin to rise, as shown in Fig. 1. In the case of a thin sheet of insulating material, where the moisture is free to get out at all points without accumulating perceptibly at any one place, the ohmic resistance will gradually decrease to a minimum and then increase generally, forming practically a smooth curve. The decrease in ohmic resistance with the rise of temperature is evidently due to the presence of moisture (provided no chemical changes take place), for after the moisture is expelled the resistance increases with increased temperature, within certain limits. Low ohmic resistance is not necessarily an indication of poor insulation, but probably an indication of the condition of the apparatus in regard to moisture. A high e.m.f. should not be applied to apparatus when the ohmic resistance of the insulation is low. Material which is badly deteriorated mechanically by heat may still have a high ohmic resistance, but very poor insulating qualities.—*Elec. Journal*, June.

Commutation Poles.—POHL.—A mathematical article on the use of commutation poles in direct-current dynamos for the purpose of obtaining perfect commutation, with a description of dynamos of this type built by the Phoenix Dynamo Manufacturing Company.—*Elek. Zeit.*, June 1.

Direct-Current Machines with Commutation Poles.—DEFRIS.—An article illustrated by diagrams on the fluxes in direct-current machines with commutation poles. The author shows how to determine the compensating effect of the commutation poles with respect to their value in percentages as well as to their extension in space. The peculiar distortion of the field curves which is observed with increasing load is due solely to the armature field. This effect is discussed in detail.—*Zeit. f. Elek.* (Vienna), May 28.

Armature Windings of Alternators.—NEWBURY.—The first part of a serial, illustrated by diagrams, on the various types of armature windings of alternators. After some remarks of a general nature, the author discusses single-phase, open-type windings.—*Elec. Jour.*, June.

Repair Shop Notes.—EVE.—A short article illustrated with diagrams on methods of repairing and testing armature and field magnet coils.—*Am. Elec.*, June, 1905.

LIGHTS AND LIGHTING.

Theatre Lighting.—A description of the lighting installation of St. George's Hall in London. Alternate fittings are wired on separate supply circuits so that in the event of either failing, the other gives still more than sufficient light to illuminate the building efficiently. In the unlikely event of both lights failing, there are still the exit lights left. The stage switchboard is described and, as a novelty for England, the use of Wirt dimmer is mentioned.—Lond. *Elec.*, May 12.

Train Lighting.—KUHLMANN AND HAHNEMANN.—Some theoretical notes on Rosenberg's train-lighting dynamo which was recently described in the Digest. The authors arrive by calculation at the same results as Rosenberg.—*Elek. Zeit.*, June 1, 1905.

POWER.

Electric Power in Steel Works.—An illustrated article on the use of electric power at the Phoenix iron and steel works in Laar, near Ruhrort, Germany. The generating plant consists of three 1,000-hp blast furnace gas engines each of which is directly coupled to a three-phase generator of similar capacity. Three additional 800-hp

sets are nearing completion. Part of the electrical energy generated is used for lighting the works and part is used for running the roller beds, while a 1,200-hp motor for driving the rolling mills is in course of erection. At present the Phoenix works make use of the roller beds for feeding the ingots to the reversible cogging mill, for transporting the blooms to the bloom shears, for handling the material at the shears, and for transporting the material after having been cut. In addition, some further roller beds are being put down in connection with the rail rolling mills, sleeper rolling mills, etc. The construction of the roller beds is described, and the saving of time which accrues from the electrical drive is brought out.—Lond. *Elec.*, May 26.

Tunneling.—Hruschka.—A continuation of his illustrated article on electrical problems in tunnel building. In the present installment he deals with electric ore drills.—*Zeit. f. Elek.* (Vienna), May 28.

Electric Power in Marble Quarries.—Walsh.—A short article showing how electricity is rapidly assuming importance in the quarrying of marble.—*Am. Elec.*, June, 1905.

Little Falls.—Warren.—A fully illustrated, detailed account of the water power development at Little Falls, Minn., and its industrial results. The plant now has a capacity of about 1,000 hp. The new building will more than double this. The rapid growth of the town resulting from the development of the water power is very remarkable.—*Eng'ing Record*, June 3.

Power Plant for Traction System.—An illustrated description of the arrangements for supplying power for the 400 miles of electric lines operated by the Old Colony Street Railway Company in Eastern Massachusetts. The central generating station, which is located at Quincy Point, was the first plant of its kind in this country to use steam turbo units exclusively for electric railway purposes. There are nine sub-stations, the voltage of transmission being 13,200.—*St. R'y Jour.*, June 10.

Steam Turbine.—An illustrated article on the steam turbines made by Willans & Robinson. The turbine is identical in principle and in the main features with the Parsons standard type, and it is only in details of design and manufacture that there are differences. These details are discussed and illustrated.—Lond. *Elec.*, May 26.

Steam Turbines.—Bibbins.—Some illustrated notes on the excellent durability of steam turbine vanes.—*Elec. Jour.*, June.

The Separation of Moisture from Steam.—Strohm.—An illustrated article describing the mechanical methods used in separating moisture from steam.—*Am. Elec.*, June, 1905.

Notes on Valves.—Hubbard.—An illustrated article describing the fundamental features of the various types of steam valves and the particular use subserved by each type of valve.—*Am. Elec.*, June, 1905.

Traction.

Three-Wire System for Traction.—Scholtes.—The Nurnberg-Fuerth Street Railways were installed in 1896 with the ordinary trolley system, but it was found that the current returning through the rails to the power house was excessive and that troubles were experienced on telephone lines in the neighborhood. The conditions were somewhat improved by the laying of new rails with good bonds. When it became necessary to install more cars and to extend the system, the drop of voltage in the feeders was found to be excessive, and it was planned to erect a sub-station to which high-tension, three-phase currents should be transmitted and converted into direct current by synchronous converters. However, this system was considered to be too expensive in first cost as well as in cost of operation, and experiments were made with a three-wire system. The results of one year were so encouraging that since October, 1903, the three-wire system has been permanently introduced on all lines in the following way: The network is divided into two groups of approximately equal load; in order to adjust the load in the two halves, arrangements are made by which it is possible to change parts of the line from one-half to the other. The half of the network which is next to the power house has positive potential in the trolley wire, while the more distant lines have negative potential. The rails form the neutral conductor. One 1,000-kw steam engine drives two 550-kw dynamos, connected in series. Storage batteries are installed in the station itself, and at the end of the line. The station battery is charged with a booster, the battery at the end of the line without a booster. The latter battery is charged at the time of low load with a small current, in order to avoid an excessive current in the rails which carry the return curent. The author compares the two-wire system and the three-wire system, by means of the diagrams shown in Fig. 2, the upper diagram referring to the two-wire system, the

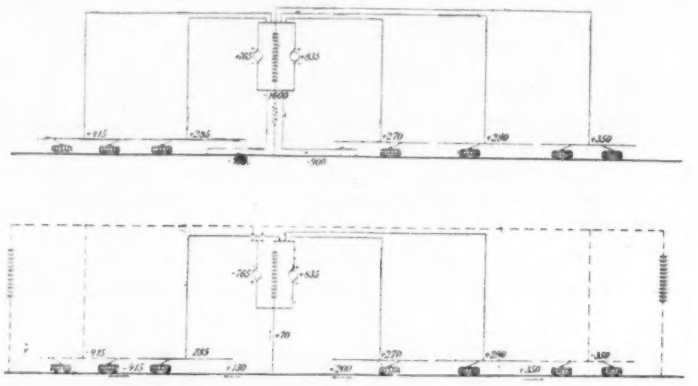


FIG. 2.—COMPARISON OF ORDINARY TROLLEY SYSTEM WITH THREE-WIRE TRACTION.

lower diagram to the three-wire system. The figures represent amperes. While in the two-wire system the rails have to carry currents of 900 to 1,600 amperes at some places, the rail currents in the three-wire system are much smaller. It was found in practice that the cables which had been installed to carry the excess of return currents while the two-wire system was in use, were superfluous for this purpose with the three-wire system. The rails were alone sufficient to carry the current, and those cables are now being used to support the feeders. This arrangement has resulted in a reduction of the electric power consumed. The author sums up the following advantages of the three-wire system: The potential difference in the rails is reduced, with corresponding smaller effects on telephone lines and with a reduction of the stray currents and their electrolytic effect on gas and water pipes. The capacity of the whole system is increased. The distance to which it is possible to extend the system is increased. Since it is possible to change at will the supply voltage in the two zones, one is able to obtain a higher voltage in the more distant zone, with a resulting greater speed of the cars, while the voltage and the speed are simultaneously reduced in the city zone. The only disadvantages are a somewhat more complicated switchboard with a higher voltage and the necessity of running always two dynamos in series. It would, of course, be possible to use only one dynamo and to supply the two halves of the system from the two halves of the battery. During the 18 months of continuous use of the three-wire system no trouble whatever has been experienced at the points where the + 550-volt and — 550-volt parts on the trolley line are joined. A comparison of the first year of the three-wire system with the last year of the two-wire system shows that the capacity has increased by 13.4 per cent, while the consumption of coal has increased by only 1.8 per cent. The author concludes that the greatest part of this increased economy is due to the introduction of the three-wire system.—*Elek. Zeit.*, May 25.

Built-up Spur Wheels for Tramway Motors.—A note stating that the Allgem. Elek. Ges., of Berlin, uses for traction purposes a spur wheel, the toothed periphery of which is made in segments bolted on to a smooth wheel keyed to the car axle. It is stated that the segments are obtained by bending bars of Siemens-Martin steel of suitable cross-section into the proper shape. Since this steel has a tensile strength of from 39 to 46 tons per square inch, as against from 26 to 32½ tons per square inch for cast steel, it is believed that such spur wheels will be more durable than those of the old type, besides being lower in cost.—Lond. *Elec.*, June 2.

Overhead Crossing.—An illustrated description of an improved overhead crossing designed to guide a trolley wheel safely. It is

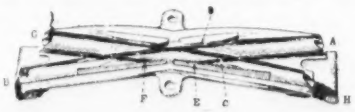


FIG. 3.—OVERHEAD CROSSING.

illustrated in Fig. 3. If we suppose a trolley wheel to be passing from *A* to *B* there is always a possibility of its fouling the point *C* of the center diamond and being thrown off the crossing. That part of the crossing marked *D* acts as a guard rail and prevents this occurrence and practically gives the equivalent of a continuous rail

to the passage of the trolley wheel at this point. When the trolley wheel advances still farther, the hard phosphor-bronze spring piece, *E*, is quite lightly sprung to one side, and then the flange of the trolley wheel meets the phosphor-bronze spring piece, *F*, which guards it from any possibility of taking the wrong wire. When the trolley advances from *G* to *H* the same actions take place.—Lond. *Elec.*, June 2.

Point Shifter.—TIERNEY AND MALONE.—An illustrated description of a point-shifter, which has been in operation on the Dublin United Tramways for some time, enabling the car driver to set the points from his platform before passing over them.—Lond. *Elec.*, May 26.

Overhead Data.—TREGONING.—An article giving a diagram for recording data of the overhead construction of a tramway system. The diagram described is used by the Hartford Street Railway.—*St. R'y Jour.*, June 3.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Size of Units for Stations.—WOODHOUSE.—A communication on the question as to what size of unit should be chosen for a station. The author considers a station to be built for a definite maximum load and with a load factor known in advance. With a 100 per cent load factor it will probably be found that three generating units will best meet the case, one being a spare. When the plant is required for a simple lighting load, the problem may best be considered by dividing it into two parts—namely, the plant required to deal with a steady day and night load and the plant required to deal with the peak. From this point of view it becomes obvious that there may, economically, be a difference in design of the plant to deal with the peak from that of the steady running plant, as, assuming the peak plant is running for an average of three hours a day, the effect of the capital charges is increased in the ratio of 24 to 3. The arguments which apply to the case of the 100 per cent load factor, apply equally to the steady load plant, but as regards the peak plant capital charges are so magnified as to dwarf coal costs, and it is impossible to come to a general conclusion without knowing the probable shape of the station load curve. If, however, a growing load is to be provided for, the case is entirely different, and the small station and the small unit must always be at a disadvantage compared with the large one. Provision for economical increase means using large units, and the limiting size of unit for a small or moderate-sized station depends only on the anticipated increase. The decrease of capital cost per kilowatt and of steam consumption per B.T.U. with steam turbines and engines is plainly apparent up to units of 5,000 kw, and there is no reason why, if steam consumption only is considered, this size should be the limit; such a unit, however, can be economically employed only when a large power load is being dealt with, and also only when the load factor is high, on account of the effect of plant load factor. Where such units are in use, the growth of the load up to, say, 30,000 kw, will not affect the efficient working of the station; above that point the special conditions of supply, as shown by the shape of the load curve, may justify an alteration. The capital charges incurred on any additional apparatus must be balanced against the saving effected by that apparatus in the proportion of the total hours per day or year to the hours per day or year in which the apparatus is in use; or capital charges = saving effected × load factor of additional plant. If this principle is borne in mind, there should be in the future no units of less than, say, 1,000 kw installed in any station in the area of a power company.—Lond. *Elec.*, May 19.

How to Calculate Regulation.—PECK.—An article giving simple methods for calculating the voltage drop in an alternating-current circuit containing resistance and reactance with loads of different power factors. If the problem is to determine the regulation of a circuit containing resistance and reactance when supplying a non-inductive load, the rule is as follows: To the ohmic volts in percentages add the square of the inductive volts, in percentages, divided by 200. If the problem is to determine the total drop in a circuit containing resistance and reactance when a load of less than 100 per cent power factor is supplied the rule is as follows: Multiply the ohmic voltage in per cent by the power factor of the load and the inductive voltage in per cent by the reactive factor of the load; the sum of the products is the total drop. (There is evidently a confusion of the term per cent.) In this rule the reactive factor means the sine of the angle of lag, so that the square of the reactive factor plus the square of the power factor is unity. By remembering the reactive factor for the most common power factors, as given in the following table, the regulation of a circuit may be calculated mentally by the above rule and without the use of charts or tables of any kind. Power factor, 95, 90, 85, 80, 70, 60 per cent.; reactive factor, 31, 43, 53, 60, 70, 80 per cent. It will be seen that for power factors above 70 per cent, the ohmic voltage has relatively a greater effect upon the regulation than has the inductive voltage, while for 70 per cent power factor they have relatively equal effects, and for power factors less than 70 per cent the inductive voltage has relatively greater effect than the ohmic voltage upon the regulation. This last point brings out the fact that where the ohmic voltage is greater than the inductive, the regulation is better with a very low power factor than with a high one.—*Elec. Journal*, June.

Oscillations in Networks.—BLONDEL.—An illustrated abstract of a paper presented to the International Society of Electricians in Paris. He discusses the application of the self-induction of the apparatus to the calculation of the oscillations and describes some experimental methods for determining the frequencies of oscillations in a network connected to a generator, for single or three-phase currents. He then discusses the propagation of oscillations along long cables.—*L'Eclairage Elec.*, June 3.

Switchboards.—PECK.—In a continuation of his illustrated serial on modern practice in switchboard design, the author discusses high-tension, hand-controlled switchboards and describes the oil switches and instruments used with the same.—*Elec. Jour.*, June.

WIRES, WIRING AND CONDUITS.

Prevention of Danger from Wooden Poles Carrying High-Tension Currents.—NORBERG-SCHULZ.—An illustrated article with reference to the report presented by Storer, Rockwell and Danforth to the Utica Convention of the New York Street Railway Association. This report dealt with experiments made to determine the danger to the general public from high-voltage transmission lines. The report concluded that wooden poles may become sufficiently charged to render them dangerous. These conditions are possible, but improbable. Nevertheless a remedy was suggested. For all wooden poles in exposed positions carrying high-tension currents it was proposed to wrap tightly a metal band around the pole about six feet from the ground and to properly ground this band. The present author states that this protection has been prescribed by law in Norway for about two years. The reason for making this regulation was a series of experiments made by the Kristiania electric works, which were quite similar to those made by the American committee. The results of these experiments are given in tables and diagrams. The Norwegian regulation requires the metal band to be placed at a height of two meters (6½ ft.) above the ground.—*Elek. Zeit.*, May 25.

Utilizing Old Lead-Covered Cables.—An illustrated article giving particulars of the methods used by the United Railways Company, of St. Louis, for drawing old feeder cables out of conduits, removing the old lead covering and rewinding them with braid for overhead service.—*St. R'y Jour.*, June 3.

ELECTROPHYSICS AND MAGNETISM.

Magnetization by Direct Current and by Alternating Current.—GUMLICH AND ROSE.—An account of experiments in which the authors determined how far magnetization by alternating current differs from that by direct current. Two questions are here to be distinguished: First, whether the magnetization of iron follows instantaneously the quick changes of the magnetic flux or whether there exists a certain viscosity on account of which the iron appears magnetically harder in more quickly varying fields; second, how far eddy currents may have influence on the result of measurements. Roessler and Niethammer have made measurements with a transformer and with a ring of dynamo sheet iron at commercial frequencies and found that the iron was magnetically harder when subjected to alternating currents than when subjected to direct current, so that in general with increasing frequency the permeability decreases while the coercive force and the hysteresis loss increase. This result is of importance since it would indicate that in the construction of alternating-current apparatus it is unsuitable to determine the hysteresis loss and the permeability of dynamo sheet iron from static measurements. On the other hand, for measuring the permeability static methods are extremely convenient. The present authors have tested four different rings of iron of 0.5 or 0.3 m. m. thickness and considerably varying with respect to the electric and

magnetic properties of the iron. The variety of the experiments was, therefore, sufficient to render the results of general applicability. In the first part of the experiments they determined the induction curve and in the second the hysteresis loss with direct current and with alternating current. Up to a frequency of about 50 periods per second, the magnetization of dynamo sheet iron of 0.5 mm. thickness differs for practical purposes only slightly from that found by direct current. At higher inductances ($\mathfrak{B} = 12{,}000$ to $14{,}000$) the difference disappears completely, while at lower fields the differences are partly due to eddy currents, but apparently to some extent also to a certain magnetic viscosity. The authors investigated the formula for the loss due to hysteresis and eddy currents:

$$\frac{W}{\rho} = A\left(\eta\ \mathfrak{B}^{1.6} + \rho\ f\ \mathfrak{B}^{2}).\right)$$

In this formula W is the loss in watts per hundred kg. of iron, ρ is the frequency, A is a numerical factor, η is Steinmetz's coefficient of hysteresis and f is the coefficient determining the eddy-current loss. The values of Steinmetz's coefficient, η, determined by means of this formula, agreed (within the limits of error of observation) perfectly with the values of η found from static measurements. On the other hand, the values of the eddy-current coefficient, f, decreases up to about $\mathfrak{B} = 12{,}000$, with increasing induction. This fact seems to indicate that the second term on the right hand of the above equation, which up to the present has always been attributed entirely to the energy loss due to eddy currents, is to a slight extent caused by the hysteresis loss. For representing the total watt loss, due to hysteresis and eddy currents, the following empirical formula has been found suitable:

$$\frac{W}{\rho} = A\left\{\eta\ \mathfrak{B}^{1.6} + \rho\ [\epsilon(12{,}000 - \mathfrak{B})\,\mathfrak{B}^{1.6} + f'\ \mathfrak{B}^{2}]\right\}.$$

In this formula the term with the factor ϵ is to be considered only up to an induction of $\mathfrak{B} = 12{,}000$, while it is to be omitted for higher fields. The values ϵ and f' are determined by the equation

$$\frac{\epsilon\,(12{,}000 - \mathfrak{B})}{\mathfrak{B}^{0.4}} + f' = f$$

by measuring experimentally f for different values of $\mathfrak{B}$.—*Elek. Zeit.*, June 1.

ELECTROCHEMISTRY AND BATTERIES.

Electric Furnace.—FITZ GERALD.—An article on the Borchers type of furnace. The author first gives an account of experiments made nearly 50 years ago by Desbrez, whose furnace may be looked upon as the progenitor of the furnace now known as the Borchers type. Its construction is described in detail and illustrated and exact rules are given for building it, special attention being paid to the design of improved forms of resistors. Results of tests are given in diagrams.—*Electrochem. and Met. Ind.*, June.

Metallurgical Calculations.—RICHARDS.—A continuation of his serial. He first calculates the temperature of the flame in the Eldred process of combustion and then gives the formula for finding the temperature in the Goldschmidt thermit process. For instance, if black cupric oxide is reduced by powdered aluminum, a temperature of 3,670° C. is attained. If pure ferric oxide is reduced by the thermit process, the temperature is 2,694°. The author then passes over to the thermochemistry of high temperatures, and discusses the following problem: Knowing the heat evolved (or absorbed) in the formation of a compound or in a double reaction starting with the reacting materials cold and ending with the products cold, to find heat evolved or absorbed. This problem is discussed in detail for different cases and illustrated by examples from metallurgical practice.—*Electrochem. and Met. Ind.*, June.

Hydrate Theory.—LOWRY.—A Faraday Society paper in which the author makes an attempt to apply to electrolytes the hydrate theory of solutions in such a way as to take account of the observations which form the experimental basis of the theory of electrolytic dissociation.—Lond. *Elec.*, June 2.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Spherical Photometer.—ULBRICHT.—An illustrated article on his spherical photometer for determining by means of one measurement the mean spherical candle-power. The author gives some theoretical considerations and discusses especially the influence of what he calls foreign bodies, which are the portions of the lamp which do not emit light themselves.—*Elek. Zeit.*, June 1.

Cymometer.—FLEMING.—His full paper on the application of the cymometer to the determination of the coefficient of coupling of high-frequency transformers, an abstract of which was recently noticed in the Digest.—*Phil. Mag.*, June.

Meter.—An illustrated description of a new direct-current meter made by the International Electric Company for currents up to 50 amperes and voltages up to 550. It is of the motor type and free from iron. At normal pressure the meter starts to register at about ½ per cent of its rated capacity and it will start at less than one per cent even if the e.m.f. is only ¾ of its normal value.—Lond. *Elec.*, May 19.

Meters.—GERHARDI.—In a continuation of his illustrated serial on electricity meters he discusses various types of Aron meters.—Lond. *Elec.*, May 26.

MISCELLANEOUS.

Experiences on the Road.—SHIPMAN.—An illustrated article in which the author describes various experiences which he has had in engineering practice, under the following headings: A generator with back lead; brush trouble; repairing field coils; pressing two spiders on their shafts; skidding a large transformer; blackening of a commutator; pumping of two direct-current generators; a transformer kink; drying out transformers (either in a vacuum or by heating with a current in the coils of the transformer itself for a period long enough to obtain satisfactory results in the insulation resistance test, with a high-resistance voltmeter, using as high a voltage as possible); and a remarkable case of resuscitation of a man who had received a shock of about 12,000 volts.—*Elec. Journal*, June.

Iron Mirrors.—BIERNACKI.—An account of experiments in which he prepared iron mirrors by disintegrating iron wires brought to a bright red heat by means of an electric current; to avoid oxidation, the wire was contained in a vacuum of hydrogen. The mirrors are deposited upon plate glass, mica or celluloid. Very perfect and uniform mirrors are obtained, showing no structure and no perforations, and having a bright metallic lustre on both sides. The mirrors are distinguished by their abnormally high remanent magnetism. The author supposed that this was due to the substance deposited consisting not of pure iron, but of a mixture of oxides with or without iron. This was suggested by the abnormally high remanent magnetism of magnetic iron ore. Two different tests, however, indicated that no oxides were present. The most immediately useful result of the author's work is that it is now possible to make mirrors which are fit for measuring instruments and are magnetic, while they are much lighter than the steel mirrors hitherto used for this purpose.—Lond. *Elec.*, June 2.

British Institution of Electrical Engineers.—Some notes on the annual meeting. The total number of members increased from 5,410 in 1904 to 5,677 in 1905. In the past session Prof. Elihu Thomson was elected an honorary member. The building fund has increased from $64,000 to $97,000 during the past year.—Lond. *Elec.*, June 2.

Manufacturing Plant.—An illustrated description of the new Pawling & Harnischfeger plant in Milwaukee.—*Iron Age*, June 15.

Electric Journal.—The *Electric Club Journal* has assumed with the June issue the new name *The Electric Journal.*

BOOK REVIEWS.

THE POLYTECHNIC ENGINEER. The Annual Organ of the Engineering Society of the Polytechnic Institute of Brooklyn. 156 pages, illustrated.

The Polytechnic Institute of Brooklyn possesses an Engineering Society, and the Engineering Society possesses the agreeable duty of publishing an annual volume of its deeds and of original articles by its members. This volume is the production for 1903-04. Its preparation for the press reflects credit upon the members of its Editorial Board.

The book is interesting, not merely as an official record of the officers of the Polytechnic Institute, but also as a compendium of valuable papers. Prominent among these is a paper on "Electrostatic Generators" by the editor-in-chief. In this a number of important experimental results are recorded concerning the properties of electrostatic machines. For example, the current strength delivered was found to be proportioned to the speed of rotation and equal to

about 120 microamperes per revolution per second, independently of the sparking distance. The internal resistance was about 3 megohms. Two machines connected together as generator and motor respectively involved a transmission of about ten watts of power, with an efficiency of over 40 per cent.

THE DYNAMICS OF PARTICLES AND OF RIGID, ELASTIC AND FLUID BODIES. By A. G. Webster. Leipzig: B. G. Teubner. 588 pages, illustrated. Price, 14 marks.

This volume is essentially a mathematical textbook intended for the use of students of physics and natural philosophy. It is of special interest to such students partly because it is remarkably condensed in its treatment, and partly because the order and plan of the treatise differ from that usually found in mathematical treatises of these subjects.

The work is divided into three parts. These deal essentially with Kinematics, Dynamics and Potential, respectively. The principles of Lagrange and Hamilton are presented with remarkable clearness and are more fully illustrated than in any other volume that we have yet examined. The motion of rigid bodies is also treated with special attention and is more fully presented from the physical and energetic standpoints than in books on dynamics.

The third part of the work contains not only a consideration of the potential function, but also a disquisition upon stress, strain, elasticity, deformation and hydrodynamics. This part of the book relates to partial differential equations and the mathematical treatment presented is of much interest.

The student of mathematical physics and of the higher mathematics will find much that is new, useful and instructive in this work. The type and illustrations are excellent.

The Morse Chain in Motor Driving.

While the constructional details of the Morse silent chain are very generally known, it may be of interest to present some characteristic examples of its application to the motor-driving of machinery where the use of any other method of driving would have introduced serious difficulties. Perhaps the most striking feature of the several chain driving applications here illustrated is the shortness of distances between centers of sprockets. In almost all instances it will be noted that the motor has been located as close to the driven machine or shaft as was possible, but the chain permits this without extra noise or other disadvantage. Especially from this point of view will this method of driving be appreciated by those who are familiar with the requirements that would be made for the use of the belt in these instances; with the belt drive applied here a great deal of space would have been wasted.

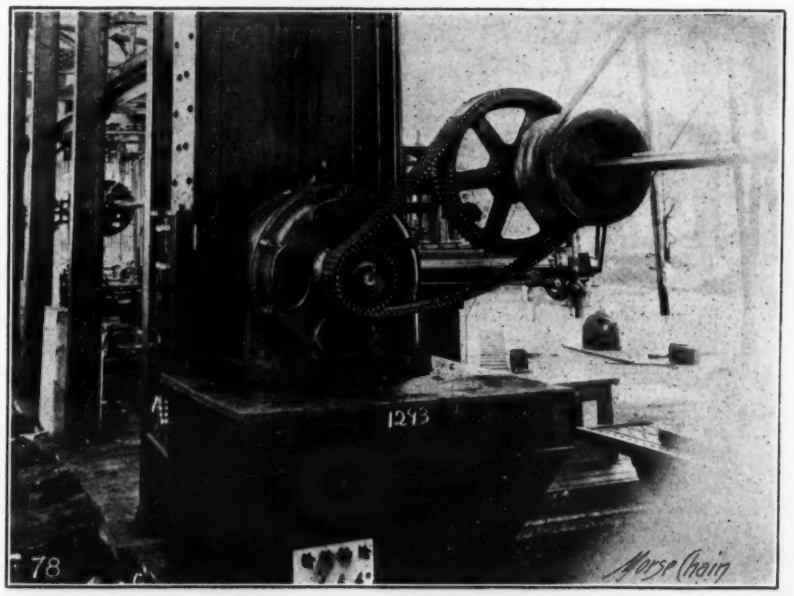


FIG. 1.—A 30-HP LIVE SHAFT DRIVE AT 30-INCH CENTERS.

Fig. 1 illustrates the convenience of the chain in connection with line-shaft drives. In this case the motor shaft is located only 30-in. from the line shaft and 30-hp is transmitted by a 5-in. chain at a linear speed of 1,242 ft. per min. Many instances of this character

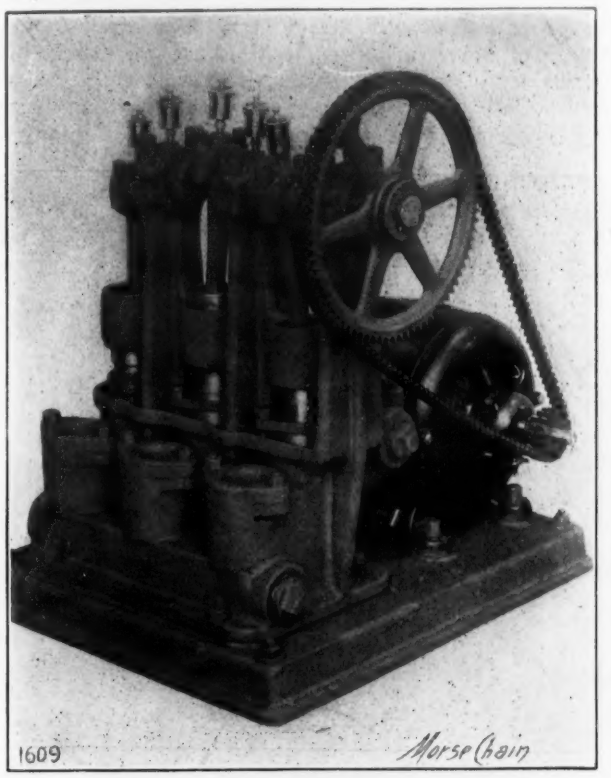


FIG. 2.—A TRIPLE PUMP DRIVE AT 25 INCH CENTERS.

obtain in machine shop work where in this way it is possible to locate the motor conveniently within reach of the floor. Fig. 2 shows the convenient design that may be used for a triplex pump in connection with a motor and chain drive. Here both are mounted upon the same bed plate with a resultant distance between centers of sprockets of only 25-in., giving, in fact, the most compact drive conceivable. In this application the chain and sprockets are protected by a shield or guard to enable the outfit to be used in the con-

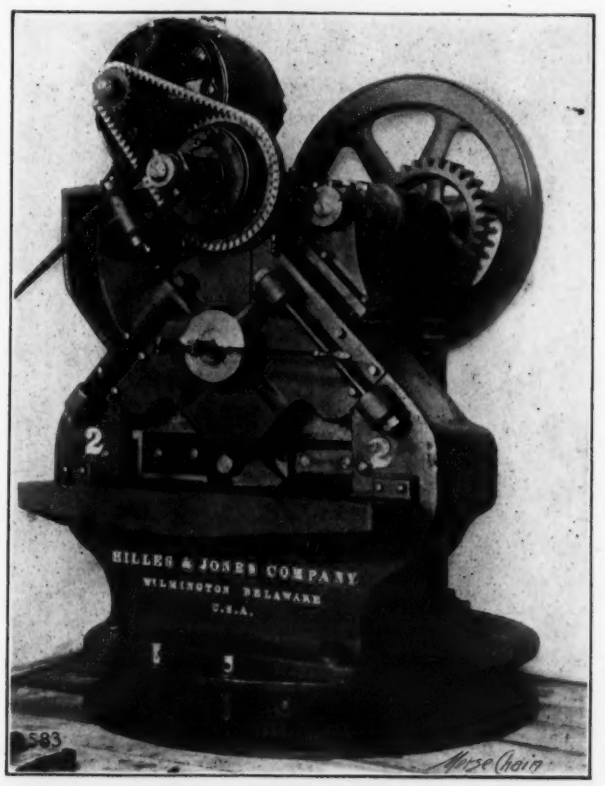


FIG. 3.—A SUCCESSFUL DRIVE UNDER CONDITIONS OF INTERMITTENT SHOCKS.

fined spaces of an office building sub-basement. This chain is of ⅝-in pitch, 1½ in. wide, and transmits 2-hp at a linear speed of 465 ft.

The peculiar adaptability of the Morse chain to machine tool driving is well known, but the accompanying illustrations are of interest in showing unusual conditions of such application. The application shown in Fig. 3, to a large angle shear, represents about as severe service as may be expected to be encountered, yet this instance is remarkable for the very successful results of the drive. While this chain is only 2 in. wide and was designed for only 10 hp,

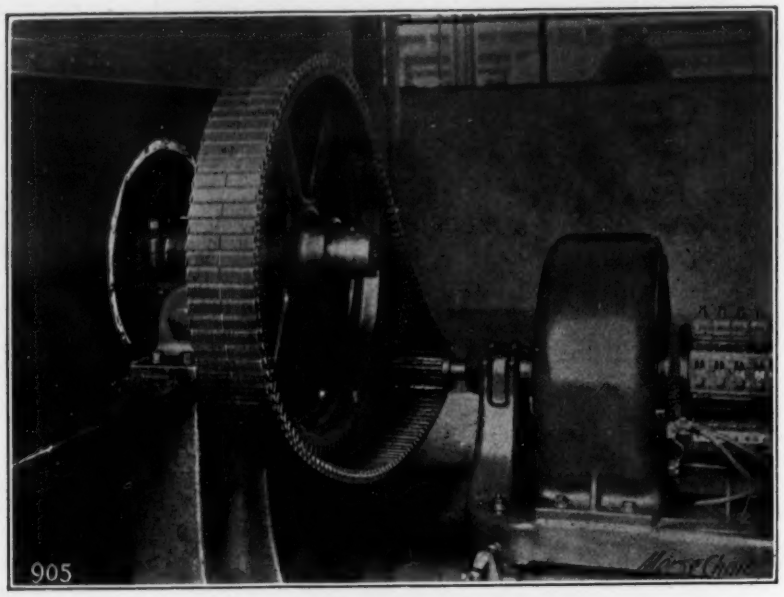


FIG. 4.—DRIVE ON SHORT CENTERS.

it is called upon to withstand the severity of a service many times larger in capacity; the character of the work is intermittent, extreme shocks coming at intervals of shearing upon the chain and motor. The chain is operated at a comparatively high speed, 1,206 ft. per min., and is found to give perfect satisfaction. Fig 4 serves to emphasize one of the advantageous features of the silent chain. Due

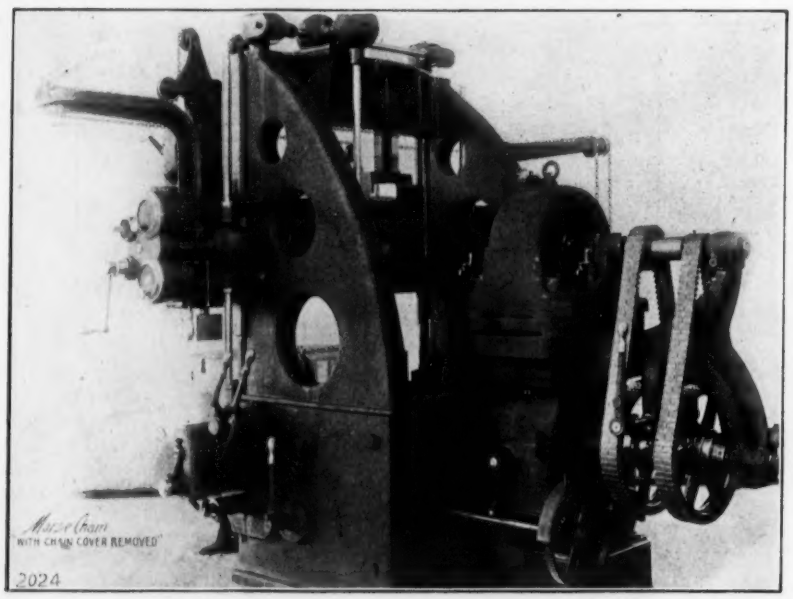


FIG 5.—A SPECIAL ARRANGEMENT OF CHAIN DRIVING FOR TWO DIFFERENT SPEEDS.

to the positive action of the chain on the sprockets, there is no need of any excess pressure on the bearings as must be true with belts on short centers. Fig. 5 shows an exceedingly compact arrangement of drive and also a special arrangement for obtaining speed changes. The unique feature of this drive resides in the fact that it has two chains with different sprocket ratios for the driving of the driven shaft at two different speeds. Both of the chains operate at 25-in. centers, one at a speed of 1,150-ft. and the other at 1,820-ft. per min. Fig. 6 illustrates a multiplicity of drives for a group of rotary pumps which was very conveniently worked out by means of the silent chain. All of the units are placed as close together as was possible and yet the chain permits of convenient drives where belts would have been impossible and gearing far too clumsy. The motor drive

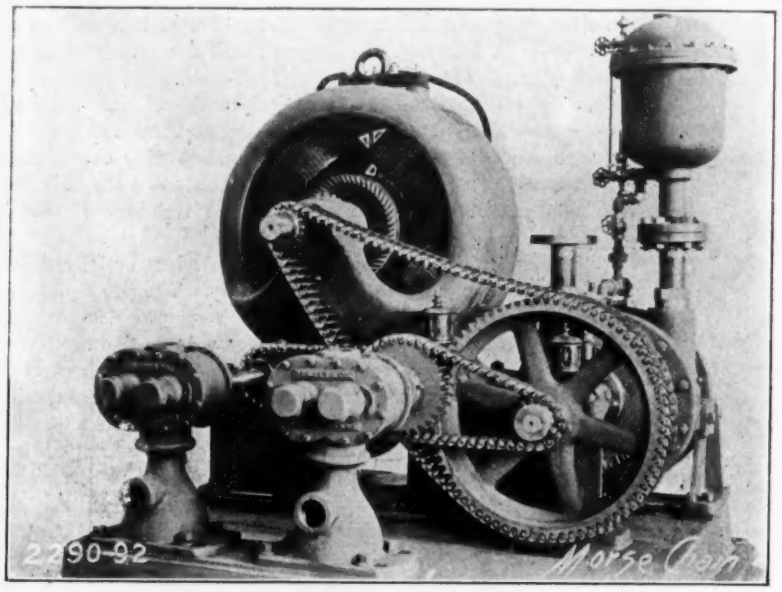
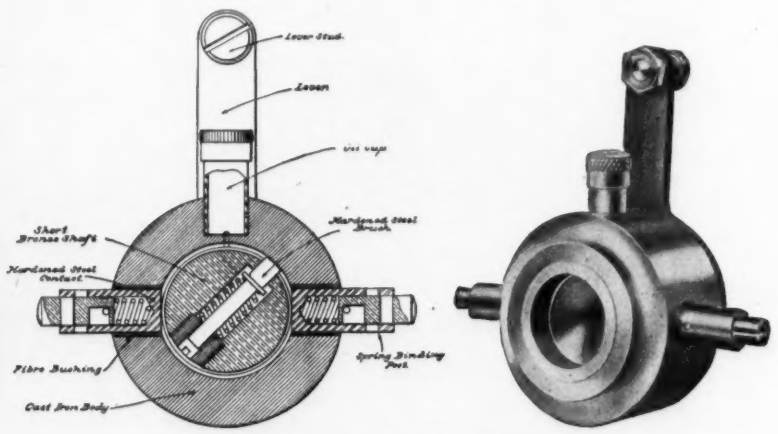


FIG. 6.—AN INTERESTING COMPLEX DRIVE.

here carries 5-hp at centers 21-in. apart and the two smaller drives, ½ and ¼-hp, respectively, operate at center distances of 8.8 and 11.8-in.

Timer Ignition Apparatus for Engines.

The Atwater Kent Manufacturing Works, of Philadelphia, who have gone quite extensively into the manufacture of ignition apparatus, are putting out a timer which embodies some new and original features. The idea in making this timer was, first, to get one which is mechanically perfect; second, to make it simple to handle and



ENGINE IGNITION APPARATUS.

keep adjusted, and, lastly, the easiest of all, to make it durable electrically.

When timers were first used, the contacts were so crude that it was necessary to examine and get at them frequently to keep them in condition. In the type here illustrated, the contacts are made so substantial that it is not necessary to examine them, and advantage has been taken of this to place the contacts in the center of the bearing. In this way they overcome a large part of the strain and wear, and all of the wobble incident to the use of many types.

The revolving part or shaft is made of phosphor bronze and the

bearing in which this revolves is of cast iron. The stationary contacts are hardened steel, insulated from the casting by a hard fibre bushing. The brush is hardened steel and rubs alternately against the cast iron and steel contacts. Practice on this timer shows, it is said, that the wear of this steel brush on the cast iron is negligible.

An oil cup located on the top provides oil for the two ends of the bearing. No dirt can possibly get into the contacts. There are absolutely no adjustments, and nothing can get out of place. The outside end of the contact forms the binding post, which is of a special spring type. The end of the lever is provided with a stud for attaching the advancing rod.

Sargent Steam Meter.

The demand for a practical device which will measure or indicate to the observer the weight of steam flowing through a pipe has led to the invention of the Sargent Steam and Compressed Air Meter, an instrument which will indicate the weight of steam or horse power irrespective of the pressure.

Fig. 1 shows the improved form of the meter. It is connected up in the steam pipe or by-pass, which allows all the steam that is to be measured to pass through, and this amount is indicated by the position of the needle on the dial. Meters are made "Right" and "Left," so that when looking at the dial the steam may flow toward the right or left as purchaser desires.

Fig. 2 is a sectional elevation of the meter showing the various

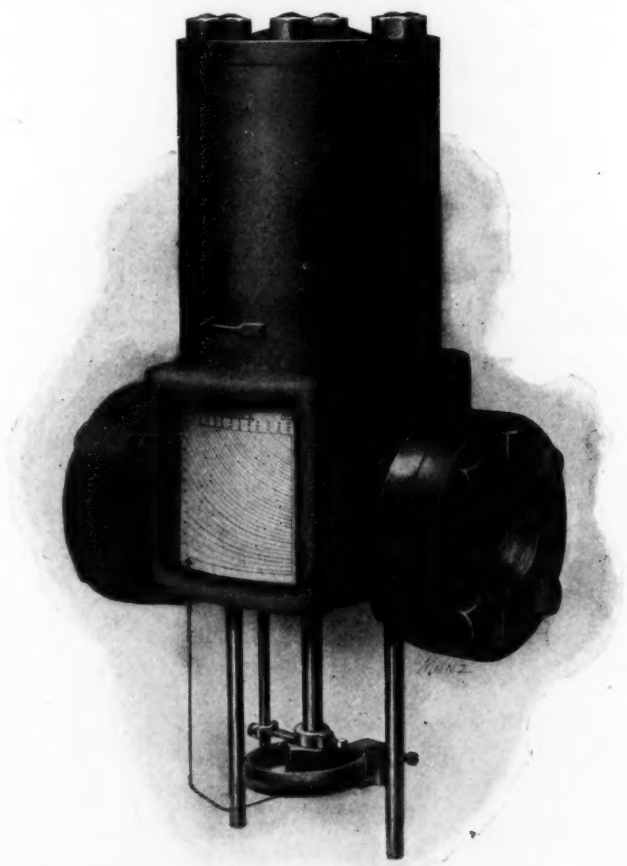


FIG. 1.—SARGENT STEAM METER.

steam passages and the moving parts. Steam enters from the left, and rising up around the valve stem guide, passes through the small hole *p*, and as the pressure increases raises the valve *i*, allowing the steam to pass down between the two cones and the valve seat to the discharge side of the meter. As the valve stem *k* is open to the atmosphere, the pressure on the discharge side of the meter tends to close the valve and force it to its seat. As the area of the valve stem is about 2 per cent. of the valve area, it follows that there will be a 2 per cent. difference in the pressure between the outlet and inlet side of meter, and that to maintain the difference the valve will assume new positions, depending on the quantity of steam flowing through. If the steam pressure were constant the rise of the valve would be in proportion to the weight of steam flowing through, but as the pressure increases more steam will go through a constant opening; or, what necessarily happens, as the weight remains constant the opening will be less as the pressure increases. In order to compensate for variations in steam pressure a Bourdon spring is connected to the bottom of valve stem which moves the needle transversely as the pressure varies. With a constant weight of steam flowing through the valve would be open twice as wide for 50 pounds pressure than it would be for 100 pounds pressure, from which we see that the horse power lines go down as the pressure

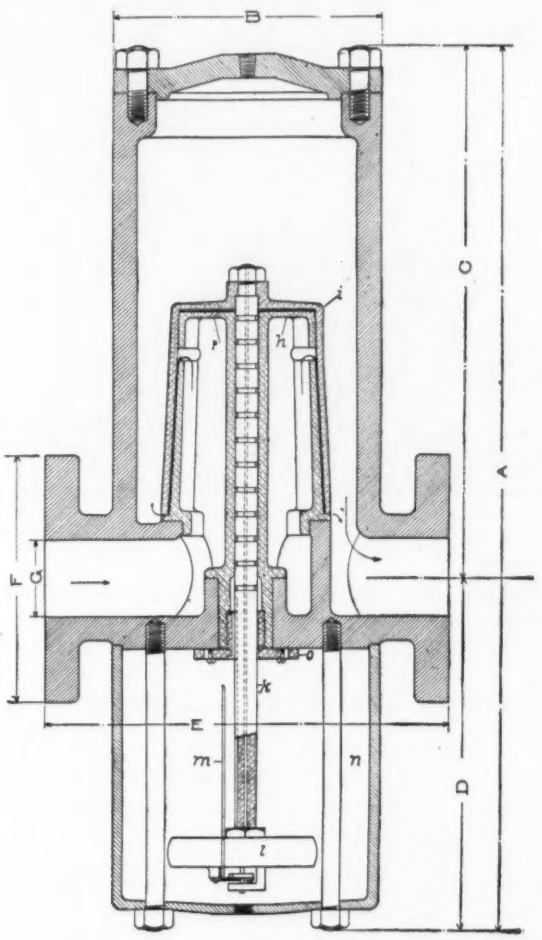


FIG. 2.—CROSS SECTION OF METER.

goes up. The meter is calibrated by weighing the condensed steam flowing through under different pressures and valve openings, and the trial dial thus obtained is transferred to the permanent metal dial of the meter. As the meter has but one moving part it is not liable to get out of order.

The meter is manufactured in sizes 1 foot to 6 feet by the Sargent Steam Meter Company, 1311 First National Bank Building, Chicago.

Lifting Magnets.

In the handling of pig iron, steel, iron scraps, baled or loose tin scraps, bolts, nuts, rivets and similar material by means of travelling cranes, much difficulty is encountered in obtaining an adequate hold upon the material to be lifted. With large castings the time consumed in connecting the hook of the crane in an eye-bolt or in placing a chain or rope in position for hoisting the casting represents an appreciable part of the cost of the completed article It is evident, however, that frequently there must be handled pieces which are too small to need eye-bolts and which cannot conveniently and economically be handled by means of ropes or chains. Even when the pieces are assembled in a containing vessel, the task of handling is only slightly simplified, since the disposal of the contents of the vessel in many cases presents a difficult problem.

An ideal substitute for chains, ropes, hooks and containing vessels for the services indicated above is found in the electromagnet,

and the accompanying illustrations serve to show a few of the numerous tasks which can be imposed upon it. Fig. 1 shows a magnet lifting steel turnings and borings. This class of material is very difficult to handle, as it is laborious to shovel, and the work is very slow and costly where a fork is used. It is light and is easily magnetized, however, and the magnet is able to carry a large quantity at each lift. Tin scrap in either the baled or loose form is ordinarily a most unwelcomed class of material. With the magnet, however, as seen in Fig. 2, it can be handled as easily and rapidly as the heavier stock.

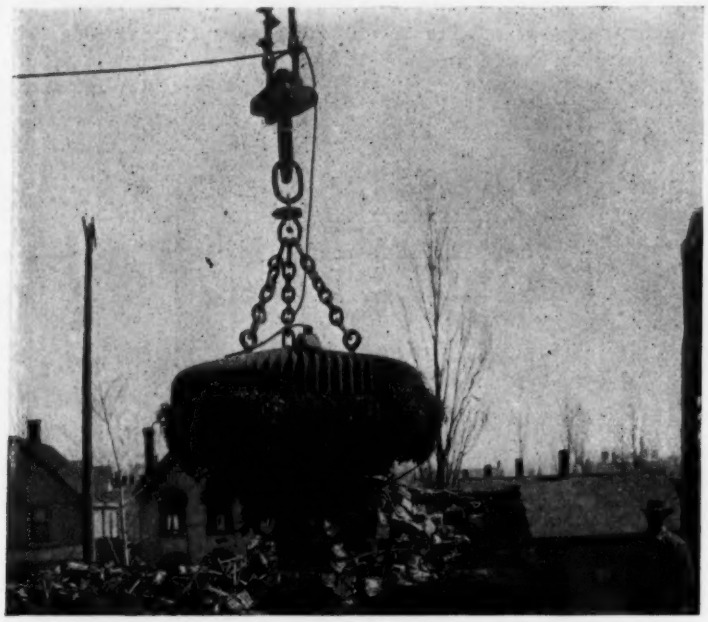


FIG. 1.—MAGNET LIFTING STEEL TURNINGS AND BORINGS.

A most interesting application of the lifting magnet is indicated in Fig. 3, which sows a magnet lifting a ball weighing 11,000 pounds, which skull-cracker is dropped for the purpose of breaking up old ingot moulds, skulls, defective castings, etc., so that they may be remelted. The entire operation is conducted from a safe distance by the crane-man, thus eliminating the danger of accident to ground-men, who are usually required for operating a mechanical trip. The crane-man simply lowers the magnet on the ball, turns on the current, raises the ball and carries it immediately over the desired striking point. He then raises the ball to the full height,

FIG. 4.—HANDLING BUNDLES OF IRON WIRE.

opens the circuit and allows the ball to drop. The aim is absolutely exact, and no time is lost in ineffective blows.

It is evident that the features of the lifting magnet which are especially advantageous in cases where the ordinary lifting devices can be applied only with great difficulty, are such as to render the magnetic device convenient for many purposes where the more familiar devices are now employed. Fig. 4 suggests the use of the

FIG. 2.—UNLOADING LOOSE TIN FROM CARS.

FIG. 3.—LIFTING SKULL-CRACKER.

magnet for carrying iron wire in bundles, while Fig. 5 shows a magnet lifting a plate of sheet iron. Plates of any thickness can be handled rapidly by the crane-man without ground-helpers.

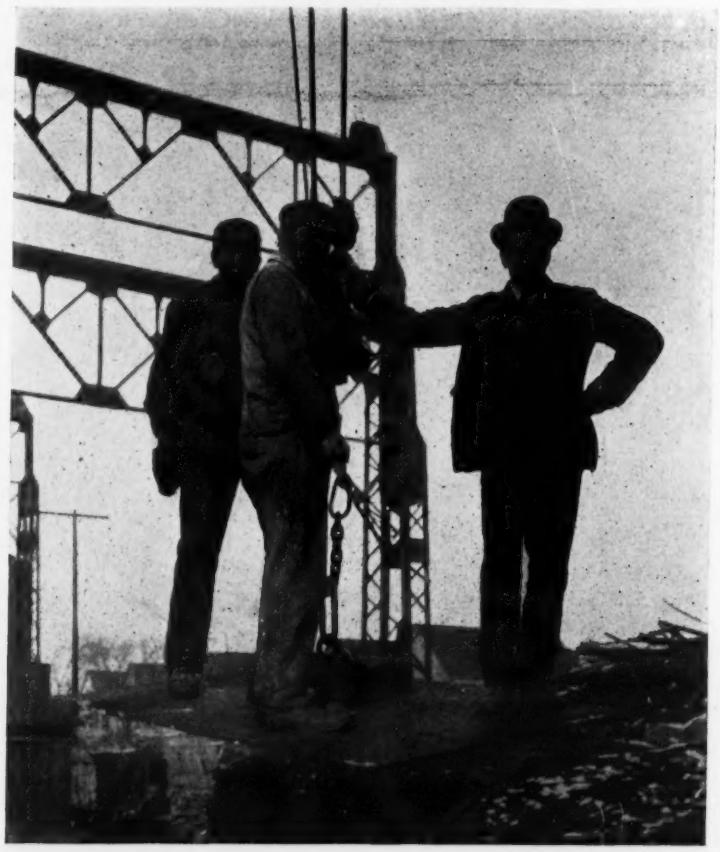


FIG. 5.—MAGNET LIFTING PLATE WITH THREE MEN.

The magnets shown in the illustrations herewith have been designed and manufactured by The Electric Controller & Supply Company, Cleveland, Ohio, which has done much work toward perfecting the electric, magnetic and mechanical details of these devices.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—A moderate improvement is noted in the commercial situation, but trade is being conducted on a conservative basis. The warm weather has stimulated business in seasonable goods, and jobbers report a greater disposition among dealers to place orders for fall and winter goods. Mercantile payments are also more prompt, the brighter crop outlook having a salutary effect on all commercial operations. Although little new business is noted in pig iron, the steel mills are busy and confidence is expressed in developments next month. During the next few weeks comparative quiet is expected in the iron and steel industry, partly because of stock-taking and repairs, but also on account of the procrastinating proclivity of consumers. Steel mills engaged on the heavier forms of finished material will not close down this summer. Textile manufacturing is in better condition than at any recent date, high prices for raw material exerting no retarding influence as yet, and most of the idleness in the leading industries is attributed to seasonable overhauling of machinery and taking of inventories. Relations of supply and demand in textile manufacturing grow more favorable for producers, many cotton spinners having contracted so far ahead that there is no urgency to make new sales. On practically all lines of staple cotton orders cannot be filled as rapidly as desired, frequent complaints being heard of tardy deliveries. Export trade is good, railway earnings are large and building is active. The labor situation, though disturbed here and there, is, on the whole, satisfactory. *Bradstreet's* report 175 failures in the United States during the week, against 194 in the preceding week, and 181 in the corresponding week of 1904. The Middle States had 49; New England, 29; Southern, 30; Western, 39; Northwestern, 6; Pacific, 18, and Territories, 4. About 87 per cent of the total number of concerns failing had $5,000 capital or less, and 8 per cent had from $5,000 to $20,000 capital. There was more activity in copper during the week, but prices remain unchanged. Lake and electrolytic are held at 15c. and casting rock at 14¾.

AUTOMATIC TELEPHONY IN 'FRISCO.—It is stated that automatic telephony is to be introduced into San Francisco. The Home Telephone Company, of San Francisco, has filed articles of incorporation with the county clerk, with offices at 310 Sansome Street, the furnishing of which has just been completed. The company has begun operations with a view to furnishing the citizens with a cheaper telephone service than they now have. The rates to be charged by the new enterprise are: Business house, per month, $8; residence, per month, $3. These are both rates for the unlimited use of the telephone. Each line is independent, and the subscriber may use it as long as he wishes. There are no party lines and no charges are made for switching. The system is automatic, the system being of the Automatic Electric Company, of Chicago. No charge will be made for the new automatic instruments until at least 7,000 of them are in actual service. The purposes of the company are set forth in detail in the articles of incorporation and are "to purchase, construct, lease and otherwise acquire and to hold, maintain and lease, sell or otherwise manage and dispose of all kinds of telephonic rights, patents, licenses, franchises, submains and other cables, machinery, wire, etc.; to deal in all kinds of telephone and electrical material, systems, apparatus, etc., and to engage in any lawful business whatever, necessary to or convenient in connection with the business of said company and authorized by the statutes of the State of California." The directors and trustees of the Home are: Henry T. Scott, San Francisco; J. S. Torrence, Pasadena; Vanderlyn Stow, San Francisco; Thomas W. Phillips, Los Angeles; John T. Mahony, San Francisco; Mark Gerstle, San Francisco, and Richard M. Hotaling, San Francisco. The capital stock is $10,000,000, divided into 100,000 shares of a par value of $100 each. The capital stock actually subscribed is $70,000, or $10,000 by each of the seven directors. This amount has been paid to J. S. Torrence, the treasurer of the company. The term of the incorporation is fifty years. The field operations of the Home Telephone Company of San Francisco are bounded only by the limits of the city itself.

COAL HANDLING PLANTS.—The Mead-Morrison Manufacturing Company, Cambridgeport, Mass., has just closed a contract for the Metropolitan Works of the Brooklyn Union Gas Company for a coal unloading plant, which will make five plants installed for this company. It has also installed a very complete system for the unloading of coal from boats for the Queensboro Gas & Electric Company. This plant consisted of an unloading rig and a shuttle cable road. It has just finished a comprehensive system for unloading coal, coke and sand from cars and depositing in storage pockets, sheds and piles, for the Bridgeport Malleable Iron Company, Bridgeport, Conn. It furnished two powerful electric storage battery locomotives for handling the product through yards and buildings. The company has also recently closed a contract for the Interborough Rapid Transit Company for a coal and ash handling equipment, which includes an unloading tower of the latest type, and four McCaslin conveyors at its Fifty-ninth Street and North River power station. It has also recently taken contracts for building a very large unloading and storage system at Port Arthur, Ontario, for the Canadian Northern Dock Company. This will be one of the largest plants ever built in the Northwest.

COPPER PRODUCTION.—Mr. Charles Kirchhoff, special agent of the United States Geological Survey, has computed the quantity and value of the copper, lead and spelter produced in the United States during 1904. A very considerable increase took place in the production of copper during 1904. The production amounted to 812,537,267 pounds, valued at $105,629,845. The production for 1903 was 698,044,517 pounds. The most noteworthy increase occurred in Arizona, where both the Bisbee and Globe districts added largely to the product. The imports in ore and matte amounted to 38,947,772 pounds; the imports in bars, ingots and old bars to 142,344,433 pounds. The exports of copper amounted to 564,544,880 pounds, a noticeable increase over the exportation of 1903, which was only 320,322,627 pounds. The amount of copper consumed in the United States during 1904 was 485,284,592 pounds, a decline from the figure for 1903, which was 566,429,885 pounds. In spite, however, of this decrease in consumption, it was necessary to draw upon the stocks in producers' hands to the extent of nearly 56,000,000 pounds.

WESTINGHOUSE ENGINES IN JAPAN.—During the years 1903 and 1904 Takata & Company, agents for the Westinghouse Machine Company in Japan, have sold no less than 56 Westinghouse engines, ranging from 600 horsepower down to 12½ horsepower, and aggregating in capacity almost 8,000 horsepower. They are all of the vertical single-acting type, both simple and compound. The list of customers comprises government arsenals, railroads, electric light companies, bureaus, water works, mines, universities and hospitals. Among the more important orders were for the Akabane Arsenal, 1,950 hp; Kure and Tokio Arsenals, 1,628 hp; Kiushiu and Nippon Railways, 579 hp; Yokoska Arsenal, 547 hp; Fukagawa and Tokio Electric Light Companies, 450 hp; Mr. Furukawa's Western Bureau, 1,265 hp; Tokio Imperial University, 93 hp; Yokohama Electric Wire Works, 62 hp, and Tokio Water Works, 31 hp.

MUNICIPAL PLANT IN 'OKLAHOMA.—The Union Light & Power Company, of El Reno, has just finished the municipal lighting plant at Andarko, Oklahoma, and has turned it over to the city. The plant was built in connection with the water works lately installed by the United States Government engineers, from the proceeds of the sales of the town and city lots at the time of the opening in August, 1901, the sales of these lots being reserved by the Government for the purpose of municipal improvements. The electric lighting plant consists of a tandem-compound McEwen engine 12 x 20 x 16 running at 250 r.p.m., directed-connected to a 110-kw, three-phase Bullock alternator. The street lighting system is the Jandus alternating-current series arc. The plant is in charge of Mr. A. C. Loudermilk, superintendent, and Charles Tomlins, chief engineer.

ELECTRIC LIGHT PLANT.—Bids will be received until June 14 by the Mayor and Town Council of Kearny, N. J., for furnishing material and erecting a municipal electric lighting plant. Separate bids to be made on the following: Power house and foundation; chimney and breeching; boilers and steam fittings; engines; generators and exciters; switchboard, wiring, transformers, pole line and fixtures, arc lamps. The cost of the plant is estimated at $55,000. Runyon & Carey, 122 Market Street, Newark, are the engineers. T. C. Wildman is town clerk.

A HIGH HEAD WATER POWER.—An article appeared in our columns recently in regard to the development of the Pike's Peak Hydro Electric Company, of Colorado Springs, Colo. It may not be generally known that the head is 2,300 feet. There is but one in the world higher, a much smaller plant in Switzerland. Three wheels have been furnished for this plant by the Pelton Water Wheel Company, of San Francisco. This head is equivalent to a pressure of 1,000 pounds per square inch.

APPARATUS FOR PERU.—Mr. A. L. M. Gottschalk, U. S. Consul at Callao, says: "The Empresa del Tranvia Urbano de Lima (Lima Horse Car Company) will receive proposals from the United States for the material which it intends to purchase in order to transform its present line into an electric trolley road. The company will need some 45 cars, with a seating capacity of 40 persons each. These are to be run by overhead trolleys. It will also purchase wires, rails, transformers, rotaries, etc. American exporters of these classes of goods should address Señor D. Joaquin Godoy, Gerente, Empresa del Tranvia Urbano, Lima, Peru, sending plans and proposals, and not English catalogues merely."

NAVAL SUPPLIES.—Bids will be received until July 5 at the Bureau of Supplies and Accounts, Washington, D. C., for furnishing at the navy yards at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Washington, D. C.; Annapolis, Md., and Norfolk, Va., a quantity of electrical supplies, incandescent lamps, wattmeters, electrical wire and conduits. Address H. T. B. Harris, Paymaster-General, U. S. N.

WESTINGHOUSE TURBINES.—The Missoula Light & Water Company, of Missoula, Mont., has placed an order with the Westinghouse Machine Company for a three-phase, 60-cycle, 2,200-volt, Westinghouse-Parsons steam turbine.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was very dull, but with a firmer tone, and decreased professional bearishness. This proceeded from the peace negotiations, coupled with better reports as to crops and railroad earnings and intimations of enlarged demands for iron and steel. The United States Steel issues commanded more or less attention, both the common and preferred showing a disposition to appreciate, which was ascribed to short covering, induced by the stories of more favorable indications about the steel trade situation. The other industrials were, however, neglected, though somewhat firmer tendencies were exhibited in their quotations. A break in Greene Copper in the curb market, attended by reports of internal dissensions, was among the incidents of the week, and Amalgamated Copper seemed to be under pressure, which was presumed to come from selling by Boston interests. Traction securities were weak and comparatively little business was transacted in them. Brooklyn Rapid Transit is off ⅝, closing at 64¼, after having reacted from 63⅝. Metropolitan Street Railway is practically unchanged, at 123, and Interborough Rapid Transit closed at 202½, which is a net gain of ½ point. The electric stocks were firmer and generally higher, General Electric closing at 176½, a net gain of 3 points, and Westinghouse closed with a net gain of ⅛ point, at 166⅛. Allis-Chalmers preferred, on the other hand, receded 1⅜, closing at 51⅛. Electric Storage Battery made a net gain of 3 points, the last quotation being 80. Western Union advanced to 94½ at the close, a gain of ½ point. Outside of the break in Greene Gold and Greene Copper shares and a rise in United States Leather issues, curb trading was without special feature. Prices closed generally steady, with transactions smaller than the previous week. Following are the closing quotations of June 20:

NEW YORK

	June 13	June 20		June 13	June 20
Allis-Chalmers Co.	14⅜	14⅜	Electric Vehicle pfd.	20	21
Allis-Chalmers Co. pfd.	51	55	General Electric	174	174½
American Tel. & Cable	90	93	Hudson River Tel.	..	..
American Tel. & Tel.	139	142	Interborough Rap. Tran.	202⅛	202
American Dist. Tel.	28	32	Metropolitan St. Ry.	122⅞	125⅜
Brooklyn Rapid Transit	64	66	N. Y. & N. J. Tel.	..	..
Commercial Cable	..	..	Marconi Tel.	..	..
Electric Boat	29	35	Western Union Tel.	93⅛	94¼
Electric Boat pfd.	71	80	Westinghouse com.	166⅛	167¾
Electric Lead Reduction	..	..	Westinghouse pfd.	..	..
Electric Vehicle	15¾	17			

BOSTON

	June 13	June 20		June 13	June 20
American Tel. & Tel	139½	142½	Western Tel. & Tel. pfd.	98	..
Cumberland Telephone	119½	119½	Mexican Telephone	1¾	1⅝
Edison Elec. Illum.	*245	*245	New England Telephone	139	140
General Electric	175	175	Mass. Elec. Ry.	17	19⅜
Western Tel. & Tel.	15	19⅛	Mass. Elec. Ry. pfd.	58	62⅜

PHILADELPHIA

	June 13	June 20		June 13	June 20
American Railways	50	52	Phila. Traction	..	..
Elec. Storage Battery	79	80	Phila. Electric	9¼	8⅜
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans.	26¾	27¼
Elec. Co. of America	11⅜	11⅞			

CHICAGO

	June 13	June 20		June 13	June 20
Central Union Tel.	..	..	National Carbon pfd.	115	120
Chicago Edison	..	..	Metropolitan Elev. com.	23¾	25
Chicago City Ry.	..	*100	Union Traction	..	..
Chicago Tel. Co.	..	..	Union Traction pfd.	..	..
National Carbon	62	63			

* Asked.

DIVIDENDS.—The Twin City Rapid Transit Company has declared a quarterly dividend of 1¾ per cent. The directors of the Union Switch & Signal Company have declared the usual quarterly dividends of 2 per cent on the common stock and 2½ per cent on the preferred, both payable July 10 to stockholders of record July 1. The St. Joseph Railway, Light, Heat & Power directors have declared the regular quarterly dividend of 1¼ per cent upon the preferred stock, payable July 1. The directors of the Manchester Traction Light & Power Company have declared a regular quarterly dividend of 1½ per cent, payable July 15. The trustees of the Massachusetts Light Companies have declared the regular quarterly dividend of 1 per cent, payable July 5. The directors of the Mackay Companies have declared the regular semi-annual dividend of 1 per cent on the common stock, payable July 1, and the regular quarterly dividend of 1 per cent on the preferred stock, payable July 1. A dividend of 2½ per cent has been declared on the preferred stock of the United Traction of Pittsburg, payable July 20. The Reading Traction Company directors have declared a dividend of 75 cents a share, payable July 1. The trustees of the Boston & Worcester Electric Company have declared a regular semi-annual dividend of 2 per cent on the preferred stock, payable July 1 to stockholders. The initial dividend of this stock was declared one year ago, this being the third payment. The American Telephone & Telegraph directors have declared the regular quarterly dividend of 1½ per cent and an extra dividend of ¾ of 1 per cent, payable July 15. Books close June 30 and reopen July 15.

THE MACKAY COMPANIES.—At a meeting in Boston on June 15, the shareholders of the Mackay companies modified in several respects the corporation's agreement and deed of trust. The changes were regarded as necessary in order "to make the organization more flexible, elastic and responsive to the will of the shareholders." The modification provides for the election of not fewer than five trustees; precludes the use of earnings to buy shares, and provides that a majority of the trustees shall constitute a quorum, and the vote of a majority of a quorum shall be conclusive. Dividends are to be paid on the first day of January, April, July and October. The trustees declared a regular semi-annual dividend of 1 per cent on the stock, payable July 1, to shareholders of record June 24.

PORTLAND GENERAL ELECTRIC.—The Portland General Electric Company, organized in 1892 with $1,250,000 preferred stock and $2,500,000 common stock, is the owner of valuable water power and canal privileges at Oregon City, Ore., and controls all the electric light and power business of Portland, Ore., serving a population estimated in excess of 135,000. For the purpose of retiring the $2,500,000 first mortgage six per cent bonds, together with what floating debt there is, as well as to pay for improvements nearing completion, it is planned to put out at once $4,000,000 five per cent bonds, dated July 1, 1905, and expiring in 1935. These bonds are redeemable at 107½ after July 1, 1905. N. W. Harris & Company and Perry, Coffin & Burr are offering the bonds for investment.

WESTERN UNION QUARTERLY.—The quarterly statement of Western Union for the three months ending June 30, 1905 (partly estimated), compares as follows:

	Estimated.	Actual.		
	1905.	1904.	1903.	1902.
Net revenue	$1,750,000	$1,802,792	$2,007,698	$1,892,476
Bond interest	331,300	292,550	286,300	254,770
Balance	$1,418,700	$1,510,242	$1,721,398	$1,637,706
Dividends	1,217,021	1,217,019	1,217,015	1,217,009
Surplus	$201,679	$293,223	$504,383	$420,697
Prev. surplus	15,821,524	14,588,205	12,515,341	10,330,306
Total surplus	$16,023,203	$14,881,428	$13,019,724	$10,751,003

INTERNATIONAL STEAM PUMP.—At the annual meeting of stockholders of the International Steam Pump Company, held in Jersey City, the following directors were re-elected: John E. Borne, Charles L. Broadbent, E. C. Converse, J. W. Dunn, Benjamin Guggenheim, J. B. Haggin (who was elected during the year to fill a vacancy and is now re-elected), H. K. Knapp, Philip Lehman, Cord Meyer (who takes the place of H. B. Hollins), Alfred Nathan, Max Nathan, Daniel O'Day, Jacob Rubino, Marcus Stine and Samuel Untermyer.

BELL TELEPHONE.—The dividend just declared on American Telephone & Telegraph's capital stock of 1½ and ¾ per cent extra compares with 1½ per cent declared three months ago, and 1½ per cent quarterly and ¾ per cent extra declared this time last year. The company has paid dividends as follows: From July, 1900, to July, 1905, inclusive, at the rate of 7½ per cent per annum, viz.: July, 2¼ per cent; October, 1½ per cent; January, 2¼ per cent, and April, 1½ per cent.

General News of the Week

The Telephone.

MOBILE, ALA.—W. C. Polk, of Toledo, Ohio, representing the Central Telephone Construction Company, has begun the work of rehabilitating the plant of the Home Telephone Company, of this city, which the Southern Bell Telephone Company made an effort to purchase several weeks ago. This is preliminary work towards arranging for a long-distance service that the company is to establish in opposition to the Southern Bell Company. It is announced that the Northern line will extend as far as Syracuse, N. Y.

JONESBORO, ARK.—The Automatic Home Telephone Company has been re-organized. The capital stock has been increased from $25,000 to $100,000.

SAN FRANCISCO, CAL.—The Home Telephone Company, of San Francisco, M. L. Gerstle, president, has filed its application for a franchise for a telephone system, covering the city and county of San Francisco, for a term of 50 years. It is specified that $2,000,000 shall be expended within 12 months. Within two years the expenditures must amount to $3,000,000 and within 3 years $4,000,000. The work is to be completed in three years, or the franchise shall be forfeited. Sealed bids are to be received for the franchise. A large number of subscribers has been secured.

HARTFORD, CONN.—A report favoring the amending of the charter of the Southern New England Telephone Company has been made by the incorporations committee. It fixes the capital stock at $500,000, with power to increase it to $10,000,000 if the stockholders so desire. It is understood that elaborate and extensive improvements are contemplated by the company.

CRANDALL, IND.—The Excelsior, Harrison County & Mutual Telephone Company will install a new exchange in this place.

OSCEOLA, IND.—The Home Telephone Company is putting in an exchange in this place. A tool line is being constructed from Mishawaka.

PRINCETON, IND.—The Princeton Independent Telephone Company is installing a new switchboard with 600 single lines, and provision for extension. This company is also installing a new outfit of batteries and generators.

GOSHEN, IND.—The Bell Telephone Company has offered to purchase the interests of the Home Telephone Company of this county, owning and operating exchanges in this city, Elkhart, New Paris, Millersburg, Wakarusa, Bristol and other towns.

PATRIOT, IND.—The Farmers' Mutual Telephone Company, of Patriot, has filed articles of incorporation. The capital stock is $500. The company will establish an exchange in Patriot and extend the lines through the north part of Switzerland County.

ELKHART, IND.—The directors of the Home Company have voted to at once place three new copper lines in service between Elkhart and Goshen, making seven in all and greatly relieving the present conditions. An additional line to New Paris has been completed.

MARION, IND.—An application has been filed by Marion Evans, a merchant, with the Board of Public Works, for a franchise for an independent telephone company, the identity of which he has not fully disclosed. The price to be charged for dwellings is not to exceed $18 a year, and the maximum charge for business houses not over $30 a year. This application, following so close on the consolidation of the interests of the United and the Central Union Telephone companies, is evidence that the independents intend recovering the lost field.

PEORIA, ILL.—Improvements which have been in progress for several months in Peoria are now completed, and several hundred new subscribers have been added.

TREMONT, ILL.—The annual meeting of the stockholders of the Tazewell County Telephone Company has been held and the following officers elected: H. L. Schmutz, of Tremont, president; Fred Reuling, of Morton, vice-president; George Bird, of Tremont, secretary and treasurer.

SANDYVILLE, IA.—The Milo & Sandyville Telephone Company, of this city, has been formed; capital, $1,000. J. Kirkpatrick and others are the incorporators.

SIOUX CITY, IA.—The Iowa Telephone Company will build an exchange to cost $40,000. It is estimated that the building and improvements will cost $150,000.

COUNCIL BLUFFS, IA.—The Council Bluffs Independent Telephone Company, in carrying out its plans for extensions and improvements, will expend $80,000 this year. Ultimately $200,000 or over will be paid out. The capital stock of the company will be increased next year.

LAINGSBURG, MICH.—The Laingsburg Telephone Company has increased its capital stock from $25,000 to $100,000.

ALPENA, MICH.—The Alpena Mutual Telephone Company has leased for five years all telephone property belonging to the Michigan State Company, in locality of Alpena, including suburban lines, cables, etc. The Mutual Company will now complete lines to Spruce, Hubbard Lake and other towns.

WYANDOTTE, MICH.—The Telephone Company will install a new telephone exchange in Wyandotte by July 1. Over 40,000 feet of new wire will be run. The company will also install a new exchange in Trenton and will, after the first of next month, give the residents of Trenton, Grosse Ile, Gibralta and Flat Rock an all-night service.

REDWOOD FALLS, MINN.—The Granite Falls Telehone Company has been organized with a capital of $50,000. K. E. Nests is president, S. O. Tjosvold is secretary.

TRENTON, MO.—The Trenton Telephone Company, of Trenton, Mo., has increased its capital stock from $8,000 to $50,000, all paid.

ST. LOUIS, MO.—At a meeting of the County Court at Clayton, the county seat, June 14, the assessed valuation of all the telegraph and telephone companies' lines in the county was fixed for next year. The returns made by the different corporations were nearly all raised.

OMAHA, NEB.—The Union Pacific is to introduce over all its lines a telephone system for the operation of trains. It will not supplant the telegraph, but will be supplementary. All trains will be equipped with telephones, which can be attached to the wires at any point for use in case of accident.

NEW YORK, N. Y.—The new telephone directory of the New York Telephone Company contains over 200,000 names, about 125,000 of which are of subscribers in the Boroughs of Manhattan and the Bronx. The edition weighs 500 tons and filled 28 freight cars. The net gain in the number of subscribers in Manhattan and the Bronx in the last three months was 15,000.

STITTVILLE, N. Y.—The Oneida Country Rural Telephone Company has been incorporated to operate in Oneida County, with central exchanges in Stittville and Holland Patent. The capital stock is $7,500. The directors are Ellis D. Jones and J. Brayton Fuller of Stittville, Ira G. Wells, John E. Jones and E. Willard Jones of Holland Patent, Griffith D. Thomas of Floyd and Elias Lewis of Steuben.

HILLSBORO, N. D.—At the annual meeting of the stockholders of the Traill County Telephone Company the following named officers were elected: A. T. Kraabel, president; A. G. Foogman, vice-president; John Carmody, secretary and treasurer.

LITCHVILLE, N. D.—The directors of the Litchville Rural Telephone Company have taken steps for the incorporation of the company and have entered into a contract with the O. A. Beeman Telephone Company for an exchange of service and use of each other's lines in Litchville.

GUTHRIE, OKLA.—The Snyder Telephone Company has been organized with a capital stock of $5,000 and the following stockholders: S. Cormack, Otis Stofer and others.

COLUMBUS, OHIO.—The Morrow County Telephone Company has increased its capital stock from $30,000 to $150,000.

PATASKALA, OHIO.—The Pataskala & Hebron Telephone Company, of this city, has increased its capital from $35,000 to $100,000.

LOWELL, OHIO.—The Lowell Farmers' Telephone Exchange, of Lowell, Washington county, capital $10,000, has been incorporated by Jerry Swain, J. M. Merritt and others.

ROCK CREEK, OHIO.—The Citizens' Telephone Company, of this city, has been incorporated with a capital of $4800. The incorporators are: C. W. Harrington, R. W. Covell and others.

COLUMBUS, OHIO.—Through a deal concluded in Columbus, the Central Union Telephone Company has "sub-licensed" all the independent exchanges in Jackson county, Ohio. These lines now connect for long-distance business with the lines of the Central Union Company and American Telephone & Telegraph Company. The Jackson county company has adopted the standard Bell instruments. The deal includes the exchanges at Jackson, Wellston, Coalton, Oak Hill and Hamden, which had a total of about 1800 subscribers.

SCOTTSBURG, PA.—The Scottsburg-Houston Telephone Company has been organized with J. T. Lacy, president, and R. A. Walden, secretary.

HONESDALE, PA.—The Lackawaxen & Hawley Telephone Company has received its charter. The line will be constructed to the Forest Lake association. It is capitalized at $5,000. J. D. Weston, of Honesdale, is one of the directors of the company.

ABERDEEN, S. D.—A mortgage has been filed by the Dakota Central Telephone Company to John C. Bassett, president of the Aberdeen National bank, as trustee, for the sum of $500,000, the amount to be used for the purpose of extending the lines, making improvements and purchasing new lines.

CANYON CITY, TEX.—The Northwest Texas Telephone Company, of Canyon City, has increased its capital stock from $10,000 to $20,000.

TEHUACANA, TEX.—The People's Telephone Company of Tehuacana has been formed; capital stock, $2,500. Incorporated by Joe Peoples, J. Desenberg and A. L. Collins.

SCOTTSBURG, VA.—The Scottsburg-Houston Telephone Company has been organized by J. T. Lacy, president; R. A. Walden, secretary.

LAWRENCEVILLE, VA.—The Brunswick Mutual Telephone Company has been organized here with $25,000 capital, by L. H. Raney, presidentt; F. W. Davie, secretary, treasurer, and I. E. Spatig, vice-president.

FREDERICKTON, N. B.—The annual meeting of the New Brunswick Telephone Company has been held. It was decided to erect a number of lines during the present season. They will include a line from Chatham to Dalhousie, connecting with Bathhurst, Campbellton and other places along the north shore, also a line from Canterbury to McAdam. Another from St. Stephen to Moore's Mills and from Lepreaux to Musquash. The company also decided to connect with the Kamaraska Telephone Company, by extending the line to Edmundston and to erect a $6000 brick building in this city for the use of the company's head offices. The following officers were elected for the ensuing year: Hon. A. G. Blair, president; J. L. Black, vice-president; Hon. F. P. Thompson, treasurer; W. E. Smith, secretary.

Electric Light and Power.

GADSDEN, ALA.—It is said that plans are on foot for the building of a power plant on Little River, near Gadsden, to cost between $1,000,000 and $1,500,000, to furnish power to many nearby towns and cities. H. T. Henderson, and brother, of Durango, Col., are interested.

LOS ANGLES, CAL.—The United States Long Distance Telegraph & Telephone Company has installed a telephone system at Corona.

SEBASTOPOL, CAL.—The Sebastopol Light, Power & Water Company has secured the franchise for the electric light and power plant, for which bids were opened June 6.

NORWICH, CONN.—The committee on incorporations of the legislature has reported favorably the petition for a charter for the Uncas Power Company of Norwich. The charter gives the company the right to manufacture and distribute electricity in the towns of Bozrah, Colchester, East Lyme, Franklin, Griswold, Groton, Lebanon, Ledyard, Lisbon, Lyme, Montville, North Stonington, Old Lyme, Preston, Salem, Sprague, Stonington, Voluntown and Waterford, and in Norwich and New London in quantities of not less than 25 horse power to any single customer. The promoters are G. O. Jackson, E. W. Higgins and Charles W. Comstock.

NORWICH, CONN.—At a recent meeting of the City Council it was voted to give to the Gas and Electric Commissioners the sum of $60,000, to be expended on repairs to the old plant and to make extensions for new business. The commissioners intend to build a new water gas plant, a new condenser plant, including scrubbers, exhausters, tar and ammonia extractors, and new purifiers. About two miles of new mains will be laid. For the electric plant there will be a new 240-kw unit direct connected, and a new stack. The city will also have 80 additional incandescent street lights of 25 cp. for the new district called East Norwich. Extensive repairs will be made on the lines.

ST. AUGUSTINE, FLA.—J. D. Lawrence, of Jacksonville, is interested in the construction of an electric light plant and street railway in St. Augustine.

MENLO, GA.—The proposed power plant to be constructed near Menlo will cost $150,000. A. J. Lawrence, of Chelsea, Ga., is interested.

STREATOR, ILL.—The Council has appropriated $30,000 for the establishment of a municipal lighting plant.

BUSHNELL, ILL.—The City Council has granted a ten-year extension of franchise to the Bushnell Electric Light & Power Company, with a provision that certain additional equipment be added to the present plant within 90 days after July 1. Two 175-hp. boilers, two 175-hp. engines and generators, and auxiliary equipment, will be purchased by the company at once.

CAYUGA, IND.—The Town Board has voted to build and equip an electric plant in this place. Bids will be invited soon for the outfit.

SUMNER, IA.—L. L. Stewart, of Omaha, Neb., has secured a franchise for an electric light plant.

FRONTENAC, KAN.—The Crawford County Light & Water Company has secured a franchise for an electric light plant. H. G. Whiteleather is city clerk.

GRAYSON, KY.—Claude Wilson, of Olive Hill, has secured a franchise for an electric light plant anl telephone system. The total cost of work will be about $25,000.

PITTSFIELD, ME.—Patrons of the electric lighting service of the Sebasticook Power Company were put on the meter system on June 1. The company has notified the consumers that an established rate had been made.

AUBURN, ME.—A contract for lighting the city's streets has been made by the Auburn city government with the Lewiston & Auburn Electric Light Company, the price being $18 a light more than the city is now paying. The company will spend about $5,000 installing a new system and will give the city a better lighting service.

BROCKTON, MASS.—The gas commissioners have refused to grant the petition of the Edison Electric Light Company of Brockton to issue $175,000 additional capital stock to take up $100,000 bonds and $75,000 notes.

SOUTH FRAMINGHAM, MASS.—The committee on public lighting has recommended that all street lights be discontinued July 1. At the annual town meeting $7,500 was appropriated for public lighting. The Edison company, however, will not light the town, under the present schedule, short of $9,000, nor will a shorter schedule be considered at a reduced price.

MELROSE, MINN.—Bids are wanted June 29 for constructing water works and an electric light plant. F. J. Weisser is city clerk.

HELENA, MONT.—The Missouri River Power Co. has decided to build a second dam across Missouri River, to develop electric power. The cost will be about $1,000,000.

FORT CROOK, NEB.—Bids will be received June 20 by Maj. M. Gray Zalinski, constructing quartermaster, U. S. A., Omaha, for an electric lighting system at Fort Crook.

CAMDEN, N. J.—The Pleasantville Electric Light Company has been incorporated with a capital of $125,000 by Chas. E. Mashold, Augustus H. Riddell and Howard F. Morgan, all of Camden.

NEWARK, N. J.—President Engers, of the Board of Works, has suggested that the city take some steps in the near future to ascertain whether it would be feasible for the municipality to own and operate an electric lighting plant when the contract with the Public Service Corporation expires three years and a half hence.

NIAGARA FALLS, N. Y.—The Niagara Falls Hydraulic Power & Mfg. Company has decided to erect a new power house and improve the canal.

NEW YORK, N. Y.—Plans have been filed for a 4-story and basement brick and stone power-house to be erected at 452 W. 27th St., by the New York Edison Co., at a cost of $50,000.

LOCKPORT, N. Y.—Geo. Schaff, of Buffalo, has secured the contract for constructing a power house for the Niagara, Lockport & Ontario Power Company, on Niagara River, for about $25,000.

PORT JERVIS, N. Y.—The Orange County Power Company has been incorporated with a capital stock of $50,000. The directors are: W. W. Handy, L. L. Marks, New York; Henry Floy, East Orange, N. J.

NEWARK, N. Y.—J. L. Rigby, W. L. Mathues and others, all of Philadelphia, Pa., it is stated, have purchased the plant of the New Light, Heat & Power Company. H. M. Whitehead, of Newark, will be manager.

NEW ROCHELLE, N. Y.—The Northern Westchester Lighting Company has consolidated all the lighting companies in Ossining, Croton, Briarcliff Manor and Pleasantville, and will probably make improvements to the plants purchased.

RHINEBECK, N. Y.—At a recent meeting of the stockholders of the Dutchess Light, Heat & Power Company of Rhinebeck, the following directors were elected: Frank Herrick, George N. Miller, Thaddeus A. Traver, M. V. B. Schryver, R. Raymond Rikert. Inspectors, Messrs. A. Lee Wager and John Williams.

KINGS MOUNTAIN, N. C.—Bids are wanted July 15 for the construction of an electric light plant, to cost about $15,000. J. C. Patrick is city clerk.

GRAHAM, N. C.—The Graham Water & Electric Light Company has been chartered, with $100,000 capital, by H. L. Millner, of New York; C. P. Hartsell and M. F. Fray, of Washington.

COLUMBUS, OHIO.—Superintendent Willcox, of the municipal electric light plant, estimates that it will cost $13,360 additional next year to give the city an all-night light schedule. His report was filed with the Board of Service yesterday. He explains that it will be necessary to put the employes on a 9-hour basis, and the employment of an engineer to handle the turbines will be imperative, suggesting as well that this engineer will have to be imported, as none is available locally. Itemizing his statement, Mr. Willcox says these additional expenditures will be necessary: Engineer, $1200; fireman, $720; oiler, $720; one laborer, $720, and additional coal, $10,000. The running time of the plant will be increased from 2000 hours to 4000 hours.

LEWISBURG, PA.—Philadelphia capitalists have purchased the gas works and the electric light plant at Lewisburg.

READING, PA.—The Reading Illuminating Company petitioned Council for a franchise to erect poles and string wires and furnish light, heat and power.

PHILADELPHIA, PA.—The Reading Railroad Company has awarded to Enos L. Seeds, of Philadelphia, the contract for constructing a power house at Port Richmond. The power will be used for the operation and lighting of the shops there.

PITTSBURG, PA.—The Leetonia Electric Light & Power Company has made application to the City Council for a franchise to install a heating plant, expecting to have the system ready by fall.

CUMBERLAND, R. I.—The proposition to establish a municipal lighting plant at this place was defeated, by a vote of 153 to 79, by the taxpayers June 14.

GREENVILLE, S. C.—The Saluda River Power Company has contracted for the building of a dam near Greenville, to develop a water power. A. G. Furman is president.

CONWAY, S. C.—The Conway Light & Power Company has been chartered by the state, with a capital stock of $10,000. D. A. Spivey is president and J. C. Spivey secretary and treasurer.

ROCK HILL, S. C.—The Catawba Power Company is making a survey on Wateree, 14 miles below Camden, with a view to constructing a power plant there. Wm. H. Martin, Jr., of Rock Hill, is secretary of the company.

YANKTON, S. D.—Sandford Donaldson has secured a franchise for an electric light plant.

LENOIR CITY, TENN.—The Lenoir City Light & Power Company, of Loudon County, Tenn., has been chartered; capital stock, $2,500. The incorporators are William Glass, R. M. Galloway and associates.

MURFREESBORO, TENN.—The City Gas & Electric Company has contracted with the city for a ten years' service of 75 arc lamps, the franchise being exclusive. Mr. J. H. Nelson is manager of the plant.

CHATTANOOGA, TENN. — The Chattanooga & Tennessee River Power Company, of Hamilton County, Tenn., has been chartered, with a $3,000,000 capital stock. The incorporators are Josephus C. Guild and others.

PETERSBURG, VA.—The town of Petersburg is considering the question of municipal ownership of lighting facilities. J. M. Quick is chairman of the light committee.

RICHMOND, VA.—Engineer E. H. Trafford has submitted a report to the committee on finance and electricity, showing that a municipal plant would net the city a revenue of over $78,000 above expenses, the sum of $16,000 to be deducted however for intrst on $400,000 construction bonds.

CHEHALIS, WASH.—Harry West, present owner of the electric light plant, will construct a 400-h-p. plant on Coal Creek, north of town.

ROSSLAND, B. C.—The West Kootenay Power & Light Company proposes to expend about $1,000,000 in improvements. The intention is to build a pole line via Dewdney trail to Cascade and to Grand Forks and Greenwood, a distance of about 83 miles.

NIAGARA, FALLS, CAN.—The stockholders of the Canadian Niagara Power Company have elected the following named directors and officers: Directors, W. H. Beatty, W. B. Rankine, A. Monro Grier, K. C., W. H. Brouse and Wallace Nesbitt; officers, president, W. H. Beatty; first vice-president and treasurer, W. B. Rankine; second vice-president and secretary, A. Monro Grier; assistant secretary, and treasurer, W. Paxton Little.

The Electric Railway.

LOS ANGELES, CAL.—The Los Angeles Interurban Railway Company is testing a novel experiment for the benefit of the traveling public. Each of its cars plying to and from the various depots will be tagged with cards announcing definite train connections.

HARTFORD, CONN.—The House of Representatives has passed a resolution authorizing the Hartford Street Railway Company to increase its capital stock from $2,000,000 to $5,000,000. A companion resolution, which has also been passed, grants to the East Hartford & Glastonbury Street Railway Company authority to increase its capital stock to $1,000,000. Both of these street railway companies have recently been absorbed by the Consolidated Railway Company.

ATLANTA, GA.—The electric railway from Atlanta to Marietta, in course of construction for two years, has just been completed and opened for travel.

EVANSVILLE, IND.—The substation of the Evansville & Princeton Traction Company, at Margaret, six miles from the city, was destroyed by fire recently, with a loss of $11,000, partly insured.

INDIANAPOLIS, IND.—The officials of the Indianapolis & Eastern Traction Company announce that within a few days they will commence through service between this city and Richmond, and this city and New Castle.

INDIANAPOLIS, IND.—A new building has been erected for the office of the train dispatcher of the Indianapolis & Cincinnati Traction Company, at the junction of the Shelbyville branch, south of this city. A telephone system is used.

INDIANAPOLIS, IND.—The Merchants' Association has adopted a plan to grant a rebate or pay the interurban fare of all out-of-town purchasers of $25 worth of goods from one or more stores. The distance is limited to 75 miles both ways.

INDIANAPOLIS, IND.—At the annual meeting of the stockholders of the Indianapolis Traction & Terminal Company the present officers were re-elected, as follows: President, Hugh J. McGowan; vice-president, H. P. Wasson; secretary and treasurer, W. A. Milholl.

INDIANAPOLIS, IND.—At the present time great interest centers in the work planned by the Widener-Elkins syndicate to bring under one control the important connecting lines of Ohio and Indiana. There is considerable evidence that the Indiana lines are getting ready for just such a consummation.

MILFORD, IND.—The stockholders of the Fort Wayne & South Bend Traction Company have elected officers as follows: President and general manager, A. J. Behymer, Elwood; first vice-president, Daniel Zook, Nappenee; second vice-president, R. A. Miller, Indianapolis; secretary, A. R. Corgore, Syracuse.

INDIANAPOLIS, IND.—The Winona Interurban Railway Company has filed articles of incorporation with the Secretary of State. The capital stock is $500,000. The company will continue its roads to Goshen and Peru, and ultimately to Fort Wayne and Logansport. Thomas Kane and other men connected with the Winona Assembly are directors.

INDIANAPOLIS, IND.—The Bluffton Construction Company, of Bluffton, Ind., is the name of a company that filed articles of incorporation with the secretary of state on the 16th inst. The capital stock is $10,000. The object of corporation is the taking of contracts to build interurban railroads. The incorporators are: F. F. Van Tuyl, Jno. B. Carter, R. F. Cummings, L. C. Justus and W. W. Edwards.

EVANSVILLE, IND.—The new auxilliary power station of the Evansville & Princeton Traction Company will be built at Pigeon Creek, where the Mount Vernon branch leaves the main lines. The company's substation at Fort Branch burned a few days ago and the company has secured power from the Evansville Gas & Light Company, in order to keep up its regular hourly service. Work on the Mount Vernon branch is progressing favorably.

INDIANAPOLIS, IND.—As the first steps in carrying out what the State administration conceives to be the law with reference to accepting passes by public officials and their deputies, the newly-created railroad commission has issud an order requiring all the railroad and interurban railroad companies in Indiana to furnish the commission with lists showing all of the free transportation outstanding June 1 of this year, together with the names of those receiving free transportation. Answers are expected by the commission within 30 days, and by July 1 the commission expects to have on file as a matter of record lists containing among other names, the names of the public officials who had passes in their possession June 1. These will be made the basis for investigation and prosecutions to enforce what the commission believe to be the law, viz: that it shall be unlawful for a railroad company to issue to, or for an official to accept of a pass from a railway company.

BALTIMORE, MD.—The United Railways & Electric Company, of Baltimore, it is stated, has passed the dividend on the preferred stock and the interest on the income bonds.

CUMBERLAND, MD.—The Cumberland & Westernport Electric Railway Company has elected the following-named officers: President, De Warren H. Reynolds; secretary and treasurer, D. P. Hartzell, Cumberland. The same board was elected for the Lonaconing, Frostburg & Midland Railway Company, representing the road between Frostburg and Lonaconing. William R. Miller was re-elected general manager of both companies.

LEE, MASS.—The Western Massachusetts Street Railway Company has the plans completed for its power house, to be located in Russell, instead of taking power from the Westfield power station. When the road is extended to Lee another power house will be necessary at Chester.

MORRISTOWN, N. J.—The Morris County Traction Company has increased its capital stock from $250,000 to $2,750,000.

NEW YORK, N. Y.—The Long Island Railroad, part of whose lines are being equipped with electricity, will introduce an innovation in inspection service by putting in a line of telephone stations and installing two gasoline motor cars. The telephones will be 2000 feet apart. The motor cars will be in constant service and immediate touch with headquarters by means of the telephones. They will carry crews of workmen and necessary tools.

NEW YORK, N. Y.—The Manhattan Railway Company has asked Comptroller Grout to grant a reduction of 30 per cent on the franchise tax bills for 1900, 1901 and 1902, because in those years franchises have been assessed at full value and real estate at only 70 per cent. For similar reasons a reduction of 20 per cent. was asked on the bills for 1903 and 1904. These reductions make a difference of over $1,000,000 in the tax bills of the elevated roads.

ROCHESTER, N. Y.—The Rochester & Eastern Rapid Railway, of Rochester, N. Y., has been sold to New York Central Railroad interests. This has given rise to the publication in Rochester papers of stories to the effect that the Rochester Railway Company, operating the city lines, also has been sold. The Rochester Railway is controlled by the Clark interests of Philadelphia. They have denied the sale of the property. From interests identified with the New York Central it has been learned that the Central has not purchased the Rochester system.

SALISBURY, N. C.—The Salisbury-Spencer Railway Company has been reorganized and elected E. M. Deane, of Grand Rapids, Mich., president; Harry B. Wales, of Michigan, general manager. Extensions are contemplated.

READING, PA.—The United Traction Company has decided to build a large power plant at Tulpehocken Creek, near Reading. The company will also enlarge its Klapperthal plant.

PHILADELPHIA, PA.—The property and franchises of the Allentown & Slatington Street Railway Company and the Lehigh Valley Traction Company will be sold under foreclosure proceedings at Allentown.

GALLATIN, TENN.—At a meeting of the charter members of the Gallatin & Suburban Railway, G. N. Guthrie was elected president, and C. H. Fidler secretary and treasurer.

CHATTANOOGA, TENN.—In addition to the construction of the interurban electric railway through Chickamauga Park and Fort Oglethrope to Ducktown, S. W. Dive will immediately secure the right of way along the old broad gauge road and construct an electric railway up Lookout Mountain.

New Industrial Companies.

THE WIRE & TELEPHONE COMPANY OF AMERICA has been incorporated at Rome, N. Y., with a capital stock of $600,000. The directors are C. F. N. Niles, Toledo; J. S. Dyett, Rome; S. C. Houghton, Syracuse, N. Y.

THE ELECTRIC CONSTRUCTION COMPANY, of Chattanooga, Tenn., with a capital of $10,000, has applied for a charter. The incorporators are: R. H. Williams, George D. Lancaster, Norris Headrick, Bruce Forshee and Bartow S. Strang.

THE BUZZELL HEAT & LIGHT GENERATOR COMPANY of Boston, Mass., has been organized. Capital, $40,000; par, $10; preferred, $20,000. President, Philip K. Macdonald, Salisbury; treasurer, Chas. A. Buzzell; clerk, Maurice H. Buzzell.

THE REFILLED ELECTRIC LAMP & SUPPLY COMPANY has been chartered in Boston, Mass. Capital, $30,000; preferred, $15,000. President, Fred A. Ewell, Boston; treasurer, Geo.. W. Faulkner, Cambridge; clerk, Frank Foss, Boston.

THE CHARLES A. THOMPSON COMPANY, of New York City, has been incorporated to manufacture electric machinery, with a capital stock of $25,000. The directors are C. A. Thompson, James Shaw, Brooklyn, and Rudolph Miehling, New York.

PARSELL & WEED, a New York City firm, has been incorporated with a capital stock of $75,000, to manufacture mechanical and electrical apparatus. The directors are H. V. Parsell and A. J. Weed, New York, and W. H. Meadowcroft, Boonton, N. J.

THE ELECTRICAL APPLIANCE MANUFACTURING COMPANY of Phillipsburg, N. Y., has been formed. Capital, $125,000. The incorporators are Albert B. Beadle, Marshall A. Maxwell, Benjamin F. Cresson, Emerson L. Franklin and Charles B. Brady.

THE E. W. BLISS COMPANY, of Paris and Brooklyn, has been incorporated with a capital stock of $150,000. The directors are: J. W. Lane, New York; W. A. Porter, Sea Cliff, N. Y., and A. Wilzin, Paris. The company will manufacture presses and dies.

THE TRIMOUNT ROTARY POWER COMPANY of Portland, Me., has been formed. Capital $100,000. President, A. W. Coombs; treasurer, C. H. Tolman, both of Portland. Directors, as above and E. E. Haston of Portland, and W. B. Sprout of Brookline, Me.

THE SEABOARD ELECTRIC COMPANY, of Norfolk, Va., has been incorporated with a capital stock of $50,000, for the purpose of dealing in electrical supplies, dynamos and other electrical machinery. The incorporators are A. L. Bosley, Baltimore, president; J. W. Little, Atlanta, vice-president; J. Binford, Jr., Richmond, secretary and treasurer.

Legal.

FORFEIT OF FRANCHISES.—The Appellate Division, Brooklyn, N. Y., in an opinion written by Justice Willard Bartlett, has decided that street-railway companies in the borough forfeit their rights to franchises for the building of railroads in the streets when such franchises are allowed to lie dormant for a period of five years, without any attempt having been made to construct the raidroad for which the franchise is granted. Many streets in Brooklyn for which franchises were granted to the Brooklyn Rapid-Transit Company and its constituent companies are affected by the decision.

Personal.

MR. FRANK C. RANDALL.

MR. FRANK C. RANDALL, as already noted in this column, has resigned the position of vice-president and general manager of the National Electric Company, which he had held since the early part of 1904, and has joined the Allis-Chalmers Company as district manager for the district of New York, with headquarters in New York City. Mr. Randall has been closely identified for years with the street railway supply interests. He began his business career in Boston, in the office of his father, who was an importer of iron and steel. After a couple of years' experience under his father's eye he took up railroading, becoming first the "performance of engines" clerk and later chief clerk of the motive department for all divisions west of Willimantic of the New York & New England Railroad. He was afterwards chief clerk of the motive department of the Boston & Lowell road, and held this position until the consolidation of the road with the Boston & Maine. He then entered the shops of the Tripp Manufacturing Company, became expert in the manufacture of electric railway car trucks and rose to the position of superintendent of the works. He left there to become Eastern sales agent for the J. G. Brill Company, and was later transferred to the west, with headquarters in Chicago. Six years later he accepted the position of Eastern sales agent for the Christensen Engineering Company, and later became general sales agent for that company and its successor, the National Electric Company. He then became vice-president and general manager. Mr. Randall brings to the Allis-Chalmers Company a most valuable knowledge of how to secure business and of the organization of a selling force, and his special acquaintance in the electric railway field must prove of great value in advancing the interests of the electrical branch of the Allis-Chalmers business.

PROF. GEO. D. SHEPARDSON, University of Minnesota, will shortly sail for a visit to Europe.

MR. A. R. EVEREST, of the General Electric Company, has been sent to the works at Rugby, England, to take charge of important interests there. He has been at Lynn for some years, and will leave for Rugby with his family in August.

MR. C. P. WAINMAN has been elected vice-president of the Northwestern Telephone Company. He has also been made vice-president and a director of the Duluth Telephone Company, and vice-president and director of the Mesaba Telephone Company.

MR. HARRY B. REED, an engineer, of Canton, O., who has been associated with Mr. John B. McDonald in Interborough Railway construction, has just married Miss Georgie McDonald, only child of his chief. They will reside in New York City.

MR. F. G. BAUM, transmission engineer for the California Gas & Electric Corporation of San Francisco is now visiting in the East, in regard to generators and other apparatus. On the way home, he will favor Tacoma with a call, and spend a few days at the Portland Exposition.

MR. H. S. McKEE, head of the American syndicate formed for the purpose of securing street railway franchises in the city of St. Petersburg, Russia, will sail soon, according to the *Wall Street Journal*, for the purpose of looking over the field. The deal was practically abandoned several months ago because of the Russian-Japanese war, but now that there is a possibility of early peace it is expected that negotiations will be resumed. If the deal goes through it will involve construction expenditures of something like $50,000,000. American capital will be used entirely in constructing the system.

MR. CHAS. E. SCHOLZ, who has recently assumed charge of the filament department of the Sawyer-Man Electric Company, has devoted his entire attention to this line of work since 1885. He graduated from the Technological School of Stralsund, Germany, in 1875, and came to the United States four years later, where he took up electrical work. In 1885 he entered the Schaeffer lamp factory, then in Cambridge, Mass., with which he remained through its several changes in ownership and removal to Marlboro, Mass., until accepting his present position. Mr. Scholz almost 20 years ago took up the problem of the cellulose filament and later perfected it to the commercial point, the Marlboro plant also supplying cellulose filaments to other lamp manufacturers of the country. Mr. Scholz has also done original work in perfecting the process for treating carbon filaments.

Trade Publications.

THE ZEPHYRS FROM FANVILLE is the title of an amusing little illustrated pamphlet issued by the Electric Company, Continental Building, Baltimore, relating to fan motor service. The various types of fans and ventilators are graphically sketched.

GRAPHITE COMMUTATOR BRUSHES.—The June number of "Graphite," published by the Dixon Crucible Company, contains the report of an exhaustive test of graphite commutator brushes. The report is a very favorable one for these brushes, the use of which is rapidly extending as their merits become recognized.

ELECTRIC SIGNS.—The Electric Motor & Equipment Company, New ark, N. J., has just issued a handsome pamphlet showing 18 samples of electric sign work of its installation. The principal views show the fronts of well-known places with electric signs installed. These attract the eye very quickly at night, and they are artistic in design. The front cover of the pamphlet is a fine piece of color work.

GRAB BUCKET.—The automatic grab bucket, manufactured by the Browning Engineering Company, is the subject of Bulletin No. 17 of that company. The bucket described and illustrated is of the square type, which it is said digs and fills itself far better thany any bucket of the "clamshell" type. This bucket is good for digging coal, ashes, cinders, coke, gravel, sand, crushed stone, slag and materials of similar character.

SEARCHLIGHT PROJECTORS.—The Carlisle & Finch Company, Cincinnati, Ohio, devotes catalogue A to searchlight projectors, which are adequately described and well illustrated. Each detail of the lense, carbon-feeding mechanism, mirror, rheostat, etc., is fully covered. The catalogue contains a long list of vessels which use these searchlights, and numerous letters from customers which serve to show that the service rendered by the lamps has been satisfactory in all respects.

TIPLESS LAMPS.—The Tipless Lamp Company, 316 Hudson Street, New York, in a recent folder shows illustrations of various styles of tipless lamps. The principal advantage claimed for these lamps is that, in the absence of tips, 10 to 25% is saved in breakage. Another important claim is for the large increase in "End-on" candle-power, or useful downward light. It is stated that they cost no more than the ordinary tipped lamp and have as long useful life as any lamp made in the United States.

LIGHTING LARGE BUILDINGS.—In a recent pamphlet the Holophane Glass Company, Glackner Building, New York, gives some interesting and valuable information on the all-important subject of lighting large buildings, offices and stores. General instructions are given for obtaining the most effective illumination under given conditions. Illustrated examples are given of different interiors calling for special treatment in the matter of light distribution. Holophane globes lend themselves admirably to the solution of problems of this nature.

COOK'S POLICY.—Mr. Frank B. Cook, 246 West Lake Street, Chicago, recently sent out to the trade a document in the form of an insurance policy, setting forth that the said Frank B. Cook does insure the subscriber against death, and against direct loss or damage by lightning, or heavy foreign currents, on telephone wires. To carry out this insurance Mr. Cook agrees to furnish his own protective devices and agrees to protect the insured against infringement suits. The "policy" contains illustrations and descriptions of the various forms of protective devices, clips, clamps, etc. A price-list accompanies the document, which is forwarded in a regular policy envelope.

MANILA ROPE TRANSMISSION AND HOISTING.—Under the above title, the C. W. Hunt Company, 45 Broadway, New York, is issuing a catalogue designated as No. 054 which, judging from its contents, could better be classed as a text-book on rope transmission. It contains numerous formulas and tables and much valuable information for the mill engineer. After discussing the production of ropes by hand work and the later developments in modern machinery for the manufacture of rope, the use of rope in power transmission schemes is treated at great length. The book contains eight appendixes dealing with the theory of rope driving and giving the results of experiments with ropes under operating conditions.

EMERSON FAN MOTORS.—The 1905 fan motor catalogue of the Emerson Electric Mfg. Co., St. Louis, besides being instructive as to these well-known machines, is attractive to the eye. The mechanical work in its production is of high grade; the illustrations are excellent and the same may be said of the letter-press The general features of these fans are illustrated and described very clearly and concisely, and the fans of the different styles individually receive particular consideration. The classes of fans include bracket, desk, ceiling, column, and exhaust fans, each style being handsomely illustrated. Every important fact connected with the design and construction of these machines is recorded for the benefit of those interested.

S. K. C. LITERATURE.—Bulletins 145 and 146 of the Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass., are of late issue. The former is devoted to the S. K. C. type, B. O. lighting, oil-insulated transformers, and the latter to polyphase induction motors. The leading chapter of the transformer bulletin points out the essentials of a first-class transformer. This is followed by a very complete and illustrated description of the B. O. type. The construction of this type of transformer is well illustrated and described. In the second bulletin, polyphase induction motors are described. The company is now manufacturing machines of this type of a new and improved design, and the particular points of advantage are described in the bulletin.

ELECTRICAL MEASURING INSTRUMENTS.—In an attractively arranged and comprehensive catalogue recently issued by the Leeds & Northrup Company, Philadelphia, Pa., are described in detail all types of electrical measuring instruments for laboratory use. The descriptive matter and illustrations are much more complete than those usually found in catalogues, the treatment given to numerous instruments corresponding more nearly to what is common in text-book literature. Among the special pieces of apparatus described are an oscillating current galvanometer for the comparison of high-frequency currents in Hertzian experiments, and high-frequency transformers, condensers and induction coils for use in Tesla experiments. Complete descriptions are given of resistivity and conductivity bridges, dynamometers, galvanometers, photometers, potentiometers, sechometers, curve tracers, etc. The catalogue forms a valuable reference manual for the electrical laboratory.

OIL CIRCUIT-BREAKERS.—The Hartman Circuit-Breaker Company, Mansfield, Ohio, has recently issued a well-illustrated bulletin devoted to oil switches and circuit-breakers. An interesting feature in the construction of the oil switches resides in the use of moulded indurated fibre for certain parts where

metal had formerly been used. This fibre, after being moulded and pressed to the desired shape, is treated by a special process which gives to it insulating qualities claimed to be substantially equal to porcelain. The oil tank of the Hartman switch is made exclusively of the moulded fibre, and requires no lining. Its weight is only a fraction of that of a metal tank, and at the same time it possesses greater strength and durability. The overload tripping coils of the circuit-breakers are operated directly from the high-potential circuit without the intervention of current transformers. The constructive features of the switches and breakers are described in detail in the bulletin, which contains a price-list of these devices for potentials up to 22,000 volts.

PELTON WATER WHEELS.—The latest catalogue of the Pelton Water Wheel Company is probably one of the most complete publications on water power ever issued. It contains 108 pages, and covers the subject of water power and its utilization in the most comprehensive manner. It explains water-wheel practice in simple language, and as concisely as possible, with special reference to the Pelton wheel, and shows the ready adaptation of this wheel to a variety of conditions. The catalogue is profusely illustrated, many of the views being of plants in actual operation. The illustrations, as such, are attractive and interesting by reason of their excellent execution; but from the broader view point they show the great development and perfection of water-wheel practice. The catalogue embraces many useful tables pertaining to water power and water wheels. Besides the illustrations of actual operating plants, are many showing a great variety of applications of wheels. Illustrated instructions for the measurements of water courses are also given, and another interesting view shows how the energy of the water is absorbed by an operating wheels. This catalogue may justly claim to be a text-book on water-wheel practice; it is a distinct advance in water-wheel literature.

ELECTRIC TALKING CLOCK.—The Electric Motor & Equipment Company, Newark, N. J., in Bulletin No. 110, gives an interesting description of the Heiny electric talking clock. This clock does not talk audibly but visibly. It is composed of monograms in which are incandescent electric lamps so arranged that when operated by a mechanism, certain groups of them are lighted, thus forming a numeral. It is necessary to have, to indicate the time, four of these monograms, the first one being a vertical row of lamps only lighted for the hours of 10, 11 and 12. The second changes every hour, the third every 10 minutes and the fourth every minute. The monograms can be arranged to be read horizontally or vertically. The mechanism operating the lamps in the monogram units is controlled by any kind of dial clock or telegraph system if standard or observatory time is required. As the lamps in the units are electrically controlled the mechanism can be installed at any convenient distance, and one set of mechanism can be used to control and operate one or any number of talking clocks or time indicators, to be single or double sided, which can be hung across the sidewalk from a building or installed on the roof. The device is valuable for use in or on a railroad station or ferry house, at which places indicating apparatus for standard time is absolutely essential. Bulletin No. 109 of the same company describes and illustrates an electrically illuminated sign, the letters of which are instantaneously formed and changed in monograms, which are controlled by a single keyboard in charge of an operator.

News of the Trade.

THE F. BISSELL COMPANY, Toledo, Ohio, announces a reduction in price of novelty wrenches. These are special wrenches made for use with novelty potheads and sleeves.

THE WAGNER ELECTRIC MFG. CO. has moved its New York district office from 220 Broadway to the Whitehall Building, Battery Place. Mr. E. W. Goldschmidt is the district sales agent.

"A. L. BOGART."—A short while ago it was our melancholy duty to report the death of Mr. A. Livingston Bogart, electrical and gas engineer. We now desire to note the fact that his daughter, Miss Ethel Livingston Bogart, has had the name "A. L. Bogart" registered and will continue the business at 123 Liberty Street, New York, as before. This young lady is familiar with all the details of her father's work, in which she assisted him for some years, and we trust that for his sake as well as her own she will continue to receive a good share of the patronage of the trade in the specialties associated with this well-known name.

THE PHELPS COMPANY, Detroit, Mich., maintained its reputation at the recent Denver convention as hustling advertisers with an exceedingly interesting display of "Hylo" lamps and self-flashing sign specialties. It has been making the Hylo for five years, yet a great many who are familiar with the original turn bulb and the pull string saw for the first time the long-distance or lazy man's lamp. The three-way switch attached to the lamp by conducting cord of any desired length makes it especially desirable for high ceilings, enclosed globes and all sorts of inaccessible localities. It is par excellence the lamp for the sleeping room and nursery, as the light can be turned on without getting out of bed when the baby cries. A meter convinced the most skeptical that the "Hylo" really does save five-sixths of the current consumption when it is turned down. Those who attended the electric light convention in Chicago two years ago remember the self-flashing Hylo lamps which attracted so much attention, and which were then exhibited for the first time. This is the double filament lamp with an automatic device in the base, which shunts the current alternatively to the large and small filaments, producing a very catchy, flashing effect. Since then the company has brought out the Skedoodle socket plug, which lights and puts out a common lamp lightning-bug fashion. Skedoodle "A," which will flash three 16-candle-power lamps. Skedoodle "J," with a capacity of 20 16-candle-power lamps, and wink-sign frames to hold any cardboard sign. These are fitted with 2-candle-power lamps and a flasher which lights and puts them out altogether. They are just the thing for daily announcements. These frames are made in three styles and are unquestionably the most eye-catching, eye-compelling device yet offered the retail advertiser. The decorated turnip lamp for advertising special brands and trade marks, such as "Carter's ink," "Old Kirk" (Rye), "Puritan" (Shoes), "Banner Lye," etc., etc., is an especially attractive device. The decorating is done by a new process and is very artistic and permanent. Each lamp is equipped with a Skedoodle device and flashes continually.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 13, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

791,785. DIRECT READING HORSE-POWER AND WATTMETER; Harry Hertzberg and William P. Snyder, New York, N. Y. App. filed Feb. 2, 1904. An ammeter and voltmeter are disposed so that their pointers cross one another. The point of intersection of the pointers indicates the watts or horse-power upon a chart beneath.

791,998. RESISTANCE FOR RHEOSTATS AND ELECTRIC HEATERS; Henry P. Ball, New York, N. Y. App. filed Nov. 23, 1904. A resistance coil is formed of sheet metal material in spiral form for the purpose of securing sufficient radiating surface, and is ribbed or corrugated throughout its length in order to stiffen the coil against saggng when heated.

792,001. FILM-COATED WIRE; John G. Callan, Lynn, Mass. App. filed June 25, 1903. (See Current News and Notes.)

792,012. SPEED LIMITING DEVICE; Hermann F. T. Erben, Schenectady, N. Y. App. filed Nov. 23, 1903. The rotary part carries a pivoted weight which flies outward under the influence of centrifugal force and trips an electric circuit closing switch.

792,014. TRANSMITTING APPARATUS FOR WIRELESS TELEGRAPHY; John Ambrose Fleming, University College, London, England. App. filed Sept. 7, 1904. (See Current News and Notes.)

792,015. TELEGRAPHIC SIGNALING KEY; John Ambrose Fleming, University College, London, England. App. filed Sept. 7, 1904. (See Current News and Notes.)

792,016. TRANSFORMER LEAD; John J. Frank, Schenectady, N. Y. App. filed Nov. 16, 1904. The usual metallic casing of the transformer is provided with tubes of insulating material which contain the terminal conductors of the transformer, each surrounded by a body of oil. The insulating tubes are ribbed upon their outside surfaces to prevent brush discharge from the terminals to the casing.

792,020. CIRCUIT BREAKER AND CLOSER FOR ALTERNATING CURRENTS; Andrew Gray, London, England. App. filed Sept. 7, 1904. (See Current News and Notes.)

792,022. ELECTRIC FURNACE; Ernst Haagn, Hanau, Germany. App. filed March 8, 1905.

792,025. MEANS FOR PROTECTING ELECTRIC CIRCUITS; John Hamilton, Jr., Boston, Mass. App. filed Oct. 16, 1903. Designed to notify a central station of excessive current leakage in telephone conduits, etc. An alarm circuit closer is actuated by an excessive difference of potential between the neutral ground and the conduits at various points.

792,035. SYNCHRONIZING DEVICE; John D. Hailiard, Jr., Glens Falls, N. Y. App. filed Nov. 23, 1904. The bus-bars and the alternator to be synchronized, excite assisting coils of a circuit closing magnet. Further assistance is given by an additional relay joined across non-corresponding terminals of the bus-bars and generator. The relay coil acts at a different phase angle whereby its strength is rapidly varying at the point of maximum effect of the assisting coils. The total effect is to make the point of actuation of the circuit closing relay sharper with respect to the phase relation.

792,043. BREAKING DEVICE FOR ELECTRIC MOTORS; Arthur Hultquist, Goteborg, Sweden. App. filed Mar. 30, 1904. An electric motor is provided with shifting switching devices adapted to change the motor into a generator and a safety circuit is provided to release the switching devices when the safety circuit is closed by a relay magnet.

792,052. ELECTRIC TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Mar. 16, 1905. An ordinary syphon recorder operates over a paper strip in the usual way, except that a shield is provided which prevents the ink reaching the paper except for a brief interval in each stroke. The result is to secure a dot transmission record.

792,066. ELECTRICAL HARNESS; William D. McGregor, Slocan, Canada. App. filed Dec. 5, 1904. Contact plates of special form are adapted to be clasped around a belt or girdle and have terminal connecting hooks formed thereon.

792,076. ELECTRIC ARC LAMP; Robert H. Read, Schenectady, N. Y. App. filed Oct. 10, 1902. In addition to the usual long range arc-striking magnets, there is provided a quick-acting short range magnet in series with the long range magnets for imparting a slight additional movement to the carbon. The result is that in case of current variation, the arc responds quickly through the short distance, so that a less resistance in series with the arc is necessitated on constant potential circuits.

792,001. CONSTANT CURRENT SYSTEM; Matthew O. Troy, Schenectady, N. Y. App. filed Dec. 12, 1903. Relates to means by which constant current transformers are prevented from being damaged by the initial current flowing therein which tends to violently move the coils apart. The primary circuit includes a resistance which is eventually cut out by a slow-acting relay having a dash-pot.

792,101. MEANS FOR PROTECTION AGAINST REVERSAL OF ENERGY; Leonard Wilson, Pittsfield, Mass. App. filed Nov. 3, 1904. Series and shunt transformers oppose one another normally and co-act to shift the relay when the current is reversed. The series transformer has a saturated core for the purpose of getting a sharper point of operation and the change of phase relation which this causes is compensated for by a special form of relay.

792,102. ALTERNATING-CURRENT MOTOR; Gabriel Winter, Vienna, Austria-Hungary, and Friedrich Eichberg, Berlin, Germany. App. filed Nov. 14, 1904. (See Current News and Notes.)

792,103. ALTERNATING-CURRENT-MOTOR CONTROL; Gabriel Winter, Vienna, Austria-Hungary, and Friedrich Eichberg, Berlin, Germany. App. filed Nov. 14, 1904. (See Current News and Notes.)

792,105. REMOTE CONTROL OF DYNAMO ELECTRIC MACHINES; Jonathan E. Woodbridge, Rugby, England, and John B. Taylor, Schenectady, N. Y. App. filed Nov. 21, 1904. Relates to a system for starting and maintaining in operation a rotary converter at a remote station oper-

ated by three-phase high-tension transmission. Resistances in the main line initially operate to start the converter gradually, and an automatic pole-changer operates to maintain the local line at a definite polarity whether or not the direct-current end of the converter happens to build up in normal or reverse direction.

792,110. CIRCUIT CONTROLLER; John M. Barr, New York, N. Y. App. filed Mar. 7, 1904. In order to prevent excessive sparking due to reversal of current in a generator circuit, shunt and series coils normally assist one another to maintain a certain resistance cut out of the circuit, but when current is reversed the shunt and series coils neutralize one another and cut in the resistance, thereby preventing sparking.

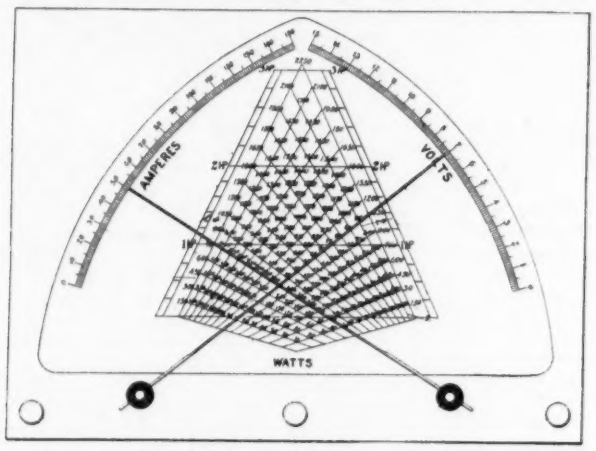
792,120. CONSTANT CURRENT REGULATOR; Frank Conrad, Edgewood Park, Pa. App. filed Jan. 20, 1904. A form of constant current transformer having a pair of secondary coils above and below the stationary primary. Both of the secondary coils are counter-balanced in such a way as to lightly approach the primary coil. The purpose is to provide increased capacity.

792,122. SYSTEM FOR TRANSMITTING ELECTRIC CURRENTS TO CARS; John J. Eagan, San Francisco, Cal. App. filed Feb. 2, 1905. An electric car receives current from fixed conductor plates along the roadway from which current is received by a sliding wire on the car, which is tightly stretched between spring blades at the ends thereof.

792,174. ELECTRIC RAILWAY SWITCH-OPERATING DEVICE; Charles W. Squire, Springfield, Mass. App. filed May 16, 1904. The switch point is operated in alternate directions by separate solenoids, which are energized through circuits controlled by an alternately moving switch. The switch has oppositely inclined cam surfaces so disposed that it is thrown in opposite directions by successive movements of its operating magnet.

792,237. AUTOMATIC ALARM AND CONTROLLER FOR SPRINKLER TANKS, etc.; Henry E. Reeve, Brooklyn, N. Y. App. filed Dec. 2, 1904. A low and high-water alarm having a float adapted to make separate circuits for low and high-water position. The float also carries a thermostat adapted to make alarm circuits for low and high temperatures to prevent freezing or boiling of the liquid.

792,248. INDUCTION COIL; George A. Campbell, Newton, Mass. App. filed Oct. 8, 1904. An induction coil or "repeater" for telephone circuits



791,785.—Direct-Reading Horse-power and Wattmeter.

designed to provide an improved electrical balance. Each of the windings are enclosed in a complete shield of conducting material insulated therefrom, and the entire coil is surrounded by a similar shield whereby the several windings are effectually screened or shielded from one another and both of the coils as a whole from any external source of disturbance.

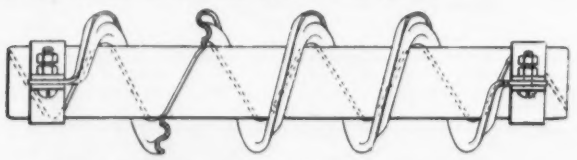
792,255. ELECTRIC FURNACE; Francis A. J. Fitz Gerald and Peter McN. Bennie, Niagara Falls, N. Y. App. filed Dec. 3, 1904.

792,257. LOW-WATER ALARM; Addison E. Gardner, Milan, Mich. App. filed Mar. 17, 1905. A low-water alarm in which a rod and a tube connecting with the boiler are supported adjacent to one another and have a lever adapted to make electrical connection by the relative expansion of the tube with respect to the rod. When the water level falls in the boiler, steam is permitted to rise in the tube expanding the same and giving the alarm.

792,258. VALVE APPARATUS; Frederick Grinnell, New Bedford, Mass. App. filed July 11, 1899. Designed to prevent closing of a valve without warning being given to a central station. The valve carries a contact blade which makes or breaks a circuit when moved from its normal position.

792,264. TELEGRAPH APPARATUS; Paul E. Heina, Paris, France. App. filed Sept. 12, 1903. An apparatus for supplying alternating currents of varying periodicity for simultaneous transmission along a single line wire of a telegraph system. A plurality of commutators is provided, each having a number of segments different from the preceding.

792,279. ELECTRIC BLOCK SIGNALLING SYSTEM FOR RAILWAYS; Claud D. McPhee, Arnprior, Canada. App. filed July 1, 1904. Within the locomotive is a dynamo geared to the engine wheels and a spring motor for closing the throttle valve of the engine. The semaphores have connections which break the circuit of the dynamo and release the spring motor to close the throttle and apply the air brakes.



791,998.—Resistance for Rheostats and Electric Heaters.

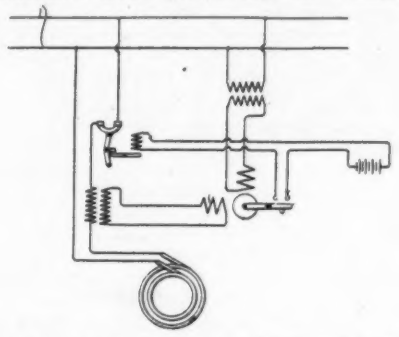
792,307. PROCESS OF ELECTRODEPOSITING ANTIMONY; Anson Gardner Bett, Troy, N. Y. App. filed May 20, 1904.

792,315. SELF-SOLDERING HEAT COIL; Frank B. Cook, Chicago, Ill. App. filed Apr. 13, 1905. A revoluble casing is soldered to a pin by an easily fusible solder and a surrounding resistance coil melts the solder when overheated and permits the casing to turn under the influence of a spring. When this casing cools again it is automatically resoldered and is restored to working condition.

792,425. ELECTRIC CUT-OUT BOX; Anton T. Kliegl and John H. Kliegl, New York, N. Y. App. filed Aug. 4, 1904. Adapted for use in conduits. The socket is supported in an inclined position facing the manhole entrance so that the plug may be removed from the socket by pulling the terminal wires.

792,435. LIGHTNING ARRESTER. Charles T. Mason, Sumter, S. C. App. filed Nov. 23, 1904. A helical coil through which the current normally passes is surrounded by a conductor of cylindrical form and uniformly spaced from the turns of the coil. The lightning jumps the intermediate space rather than traverse the inductive resistance.

792,442. DISCHARGING ROD; Joseph Morwitz, Philadelphia, Pa. App.



792,101.—Means for Protection Against Reversal of Energy.

filed May 17, 1904. Contacts are arranged around a revolving insulated cylinder so that a Leyden jar may be discharged into various desired circuits in predetermined order.

792,443. APPARATUS FOR CONDENSING ELECTRICITY; Joseph Morwitz, Philadelphia, Pa. App. filed Dec. 2, 1904. Involves a nest of condensers of successively increasing potential toward the center whereby a maximum potential difference is secured between the inner and outer coatings.

792,466. ALTERNATING-CURRENT MOTOR; Leo Schüler, St. Louis, Mo. App. filed June 17, 1904. (See Current News and Notes.)

792,467. METHOD OF OPERATING ALTERNATING-CURRENT MOTORS; Leo Schüler, St. Louis, Mo. App. filed July 5, 1904. (See Current News and Notes.)

792,528. WIRELESS TELEGRAPHY; Guglielmo Marconi, London, England. App. filed Jan. 27, 1904. (See Current News and Notes.

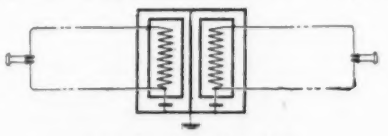
792,530. ELECTRIC FUSE; Norman Marshall, Newton, Mass. App. filed June 27, 1903. The main fuse is enclosed within a casing and packed in non-conducting material. An auxiliary fuse passes through an explosive powder box and indicates the condition of the main fuse which cannot be observed by reason of the packing material.

792,552. LAMP HOLDER; William J. Phelps, Detroit, Mich. App. filed Sept. 22, 1902. Relates to a form of lamp socket switch by which lamps containing two filaments for high and low illumination are provided. The lamp has separate terminals which can be respectively shifted into the path of the key so as to close the different circuits through the separate filaments as desired.

792,568. BINDER FOR COILS OF ROTATING ELEMENTS; Bernard A. Behrend, Norwood, O. App. filed Nov. 6, 1903. The core windings are provided with end connections which are similarly inclined, and independent cross pieces are provided which extend over a plurality of said inclined end connections to bind the same into position, said cross pieces being secured to the head end of the core.

792,569. ELECTRIC RAILWAY; William Chapman and Percy W. Davies, Pittsburg, Pa. App. filed Nov. 23, 1897. The trolley conductor is exposed between the rails, but is divided into sections which are normally dead, but successively charged as the car passes over them by "pick-up or energizing circuits." As the contact shoe passes from a section which has been energized to the succeeding section it forms a bridge which establishes a circuit for energizing such succeeding section, and the energization of the sections thereby progresses successively through the entire line.

792,571. ELECTRIC MOTOR SYSTEM; Adolph F. Christmas, Pittsburg, Pa. App. filed Sept. 23, 1904. Relates to a system of operating a motor of the type in which a core reciprocates between two solenoids, for the purpose of



792,248.—Induction Coil.

coal breakers, rock drills, etc. A mercury circuit breaker is used and special means are arranged for varying the relative time of make and break thereof so as to properly synchronize it with the movement of the core.

12,356. RECIPROCATING ELECTRIC ENGINE; Bruno O. Wagner, El Paso, Tex. App. filed Apr. 20, 1905. A series of coils are successively energized to draw a core backward and forward by means of a rotating commutator which is driven from the reciprocating part of a connecting rod, a fly wheel being used to carry the commutator over its dead centers.

12,359. PLUG OR BRUSH FOR CONNECTING WIRES OR BARS TO PIECES OF METAL; Ernst A. Richardson, Bordeaux, France. App. filed Sept. 8, 1904. Rail bond wire is gripped by the use of split conical wedges in the usual way, except that the heads of the conical wedges have recesses in which the ends of the bond can be bent over and clinched so as to be held more firmly.

792,191. GALVANIC BATTERY; Benjamin J. Blameuser, Chicago, Ill. App. filed Aug. 1, 1904.

792,195. ROTARY MERCURY CIRCUIT BREAKER; Adolph F. Christmas, Pittsburg, Pa. App. filed Aug. 15, 1904. A cylindrical metal casing is partially filled with mercury and a pair of terminals rotate therein to make successive contacts with the mercury so that sparking is not injurious. To further secure this result several circuit breakers are coincidentally actuated, dividing the circuit-breaking arc among them.

792,196. ROTARY MERCURY CIRCUIT BREAKER; Adolph F. Christmas, Pittsburg, Pa. App. filed Sept. 23, 1904. Relates to modifications of the above in which a three-part cylindrical casing has mercury in the successive chambers and perforations are provided to make and break circuits between the chambers at each half revolution. The break thus occurs between two mercury contacts.

792,225. WALL PLUG FOR INCANDESCENT ELECTRIC LAMPS; Charles J. Malish, Toledo, O. App. filed Oct. 31, 1904. A swiveling plug to prevent untwisting of the flexible cord. The swiveling parts are provided on their opposed faces with annular contact rings through which one of the connections is made, and a central screw rod is effective to complete the other.

792,230. HOT AIR INHALER; Norman K. Morris, Denver, Colo. App. filed Mar. 5, 1904. Comprises a casing having air inlets and an outlet tube through which air may be inhaled. The interior of the casing is heated by a resistance coil.

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ELECTRICAL WORLD AND ENGINEER

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ALPHABETICAL INDEX TO ADVERTISERS, PAGES 28 AND 30.

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Yours truly,
C. B. HIBBARD.

Not a Complaint.

BUFFALO, N. Y., Dec. 13, 1904.
THE LECLANCHÉ BATTERY CO.
Gentlemen:
I placed in the residence of Ex-Mayor Philip Becker 4 cells of your battery, and connected them with an 18 Call Annunciator, in August, 1887. I have just recharged them with Sal Am & zincs for the third time and they still hold their own.
Have you any better showing than this?
Yours truly,
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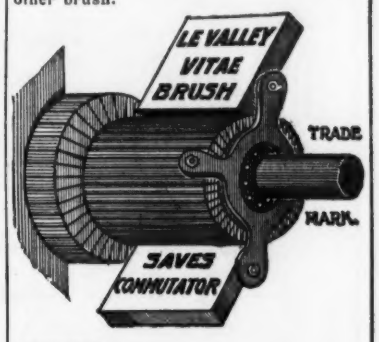

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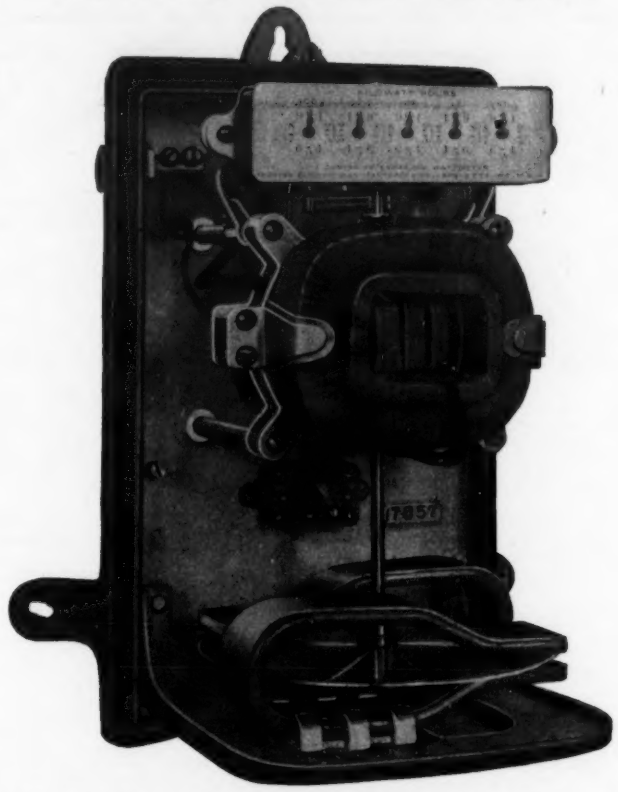

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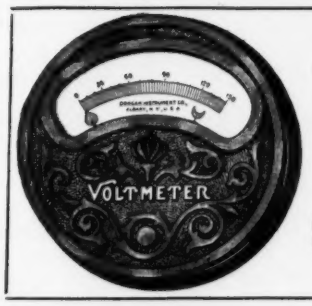

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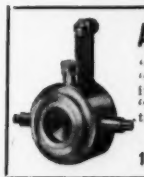

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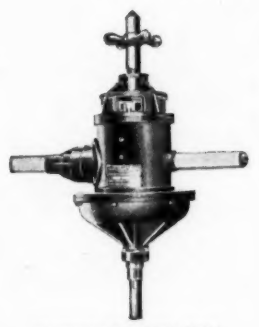

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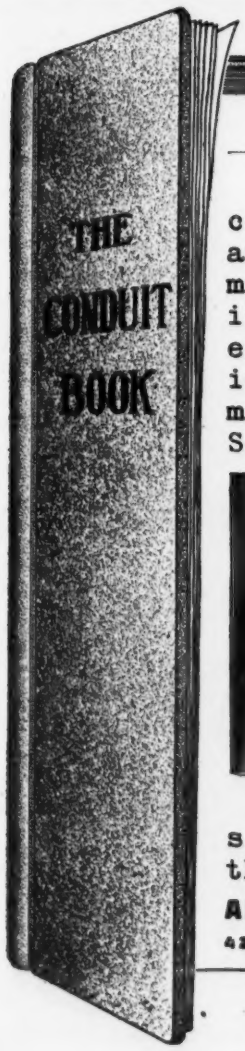

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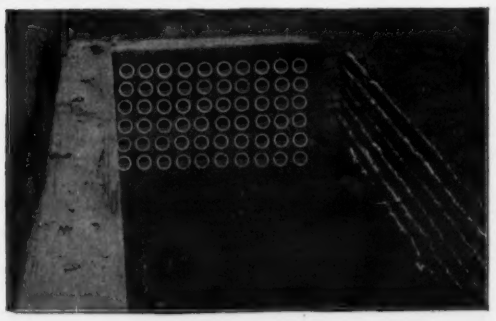

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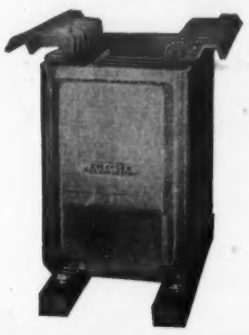

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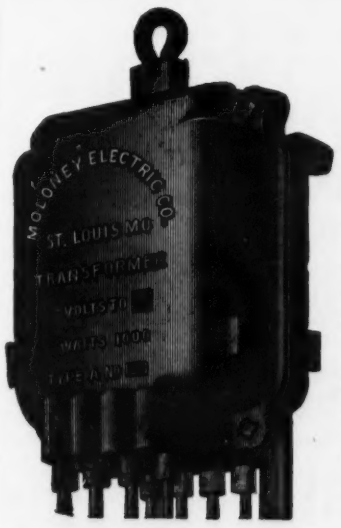

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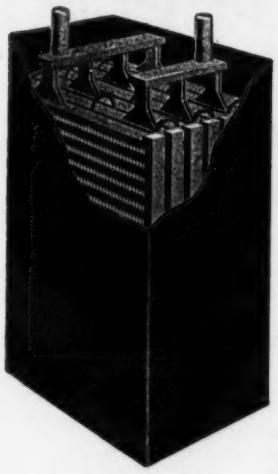

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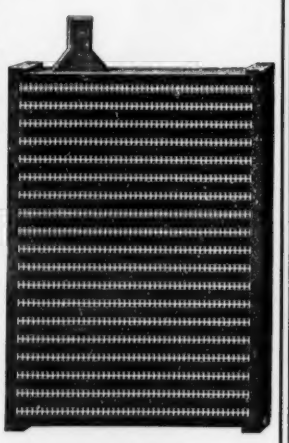

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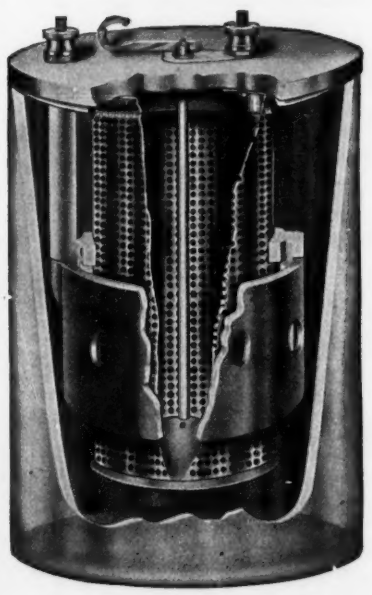

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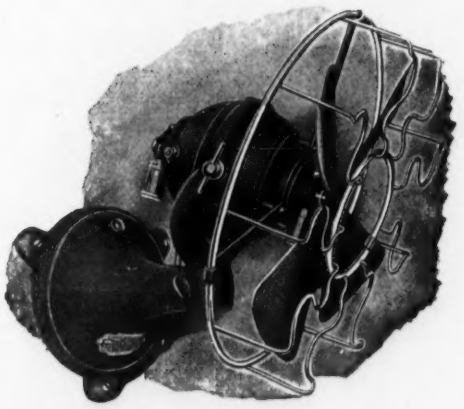

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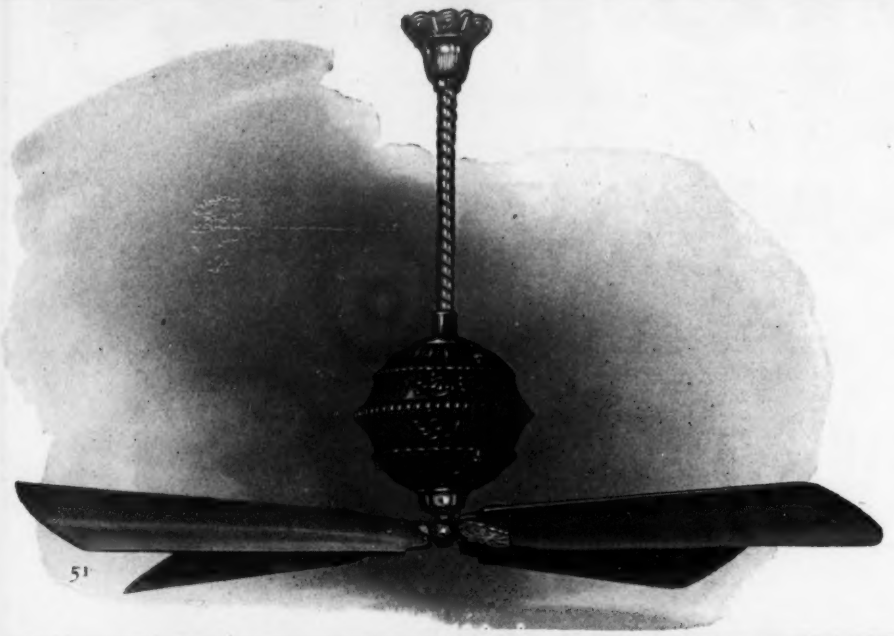

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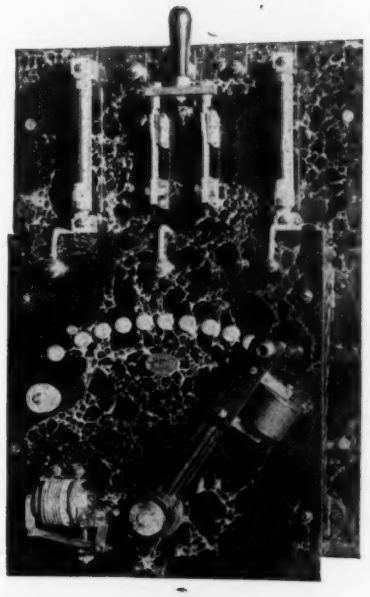
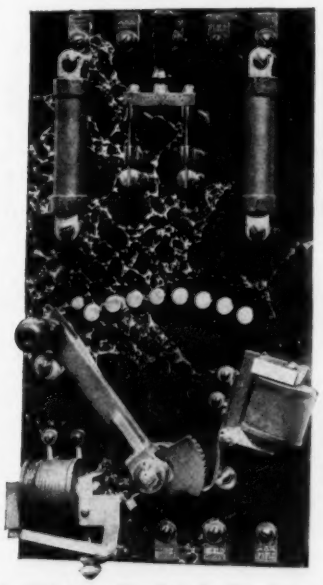


C-H "Universal" Motor Starter.



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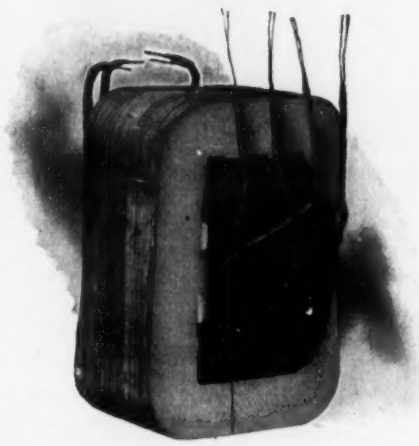

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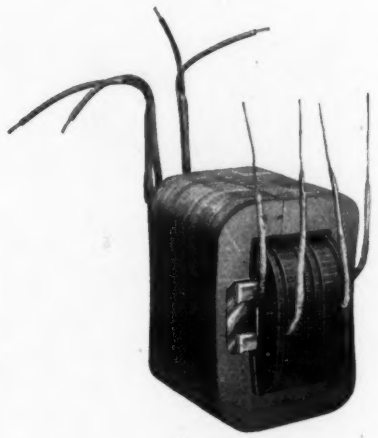

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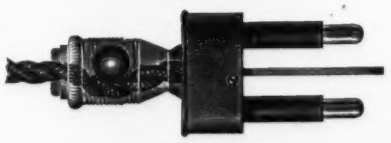

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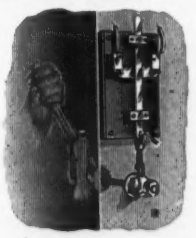

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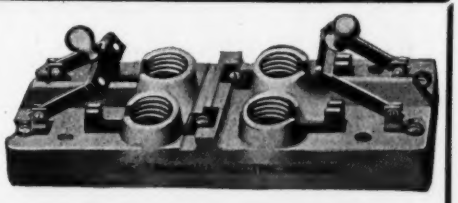

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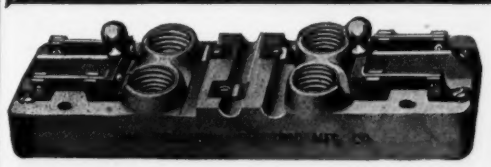

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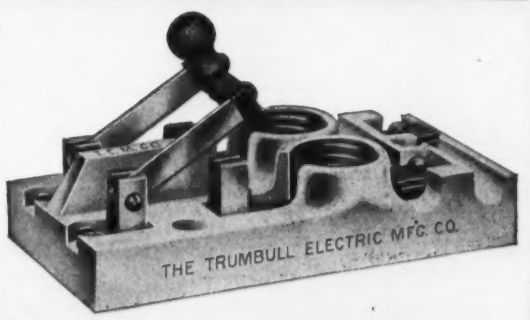

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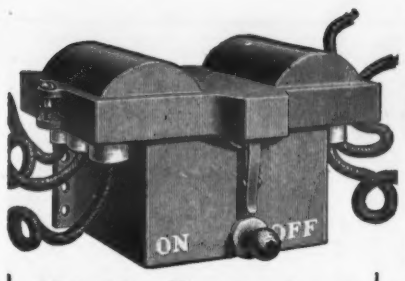

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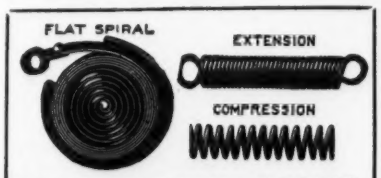

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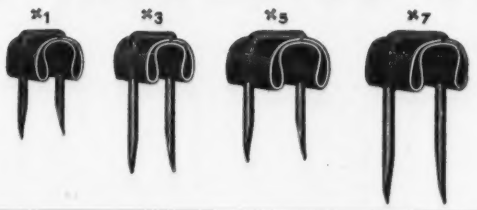

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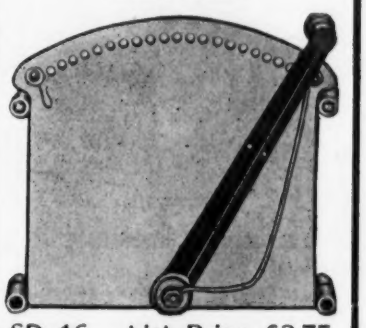

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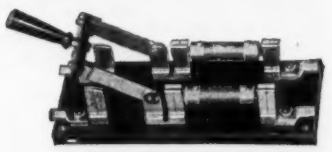

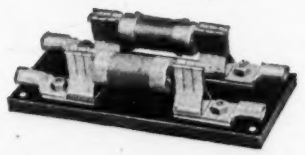

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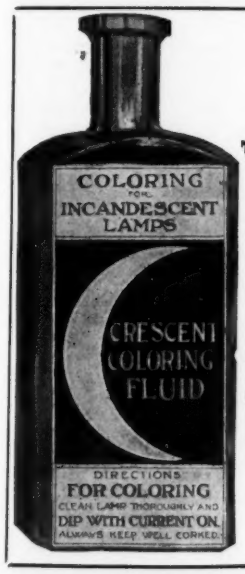
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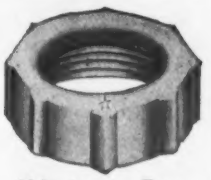

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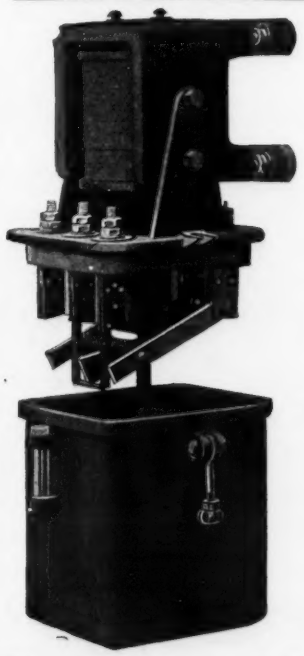

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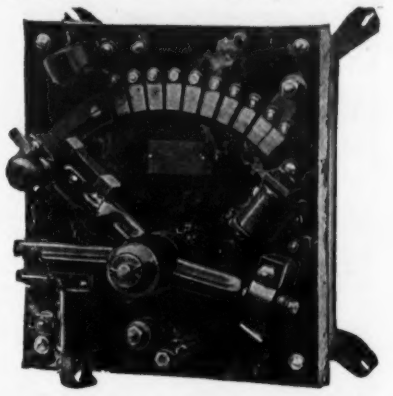

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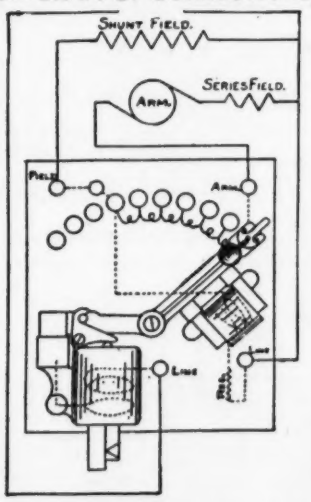

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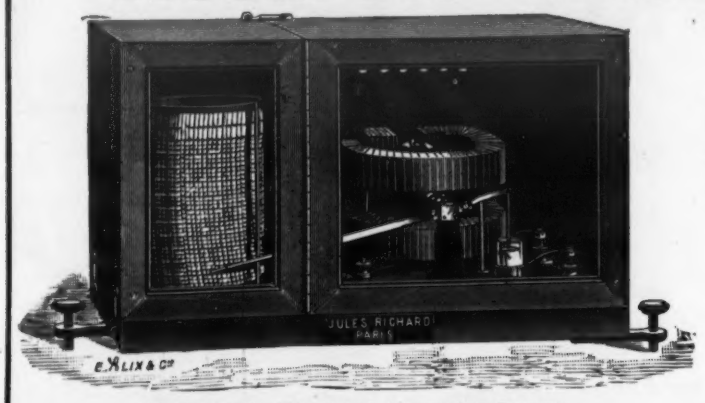

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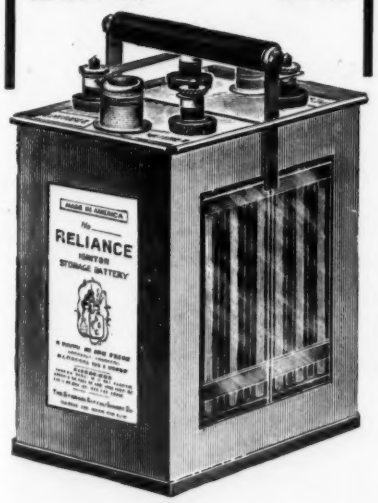

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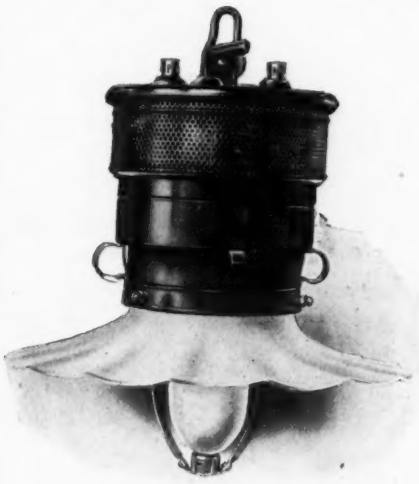

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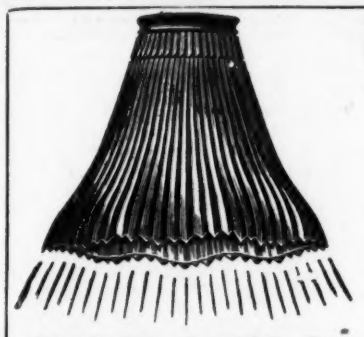

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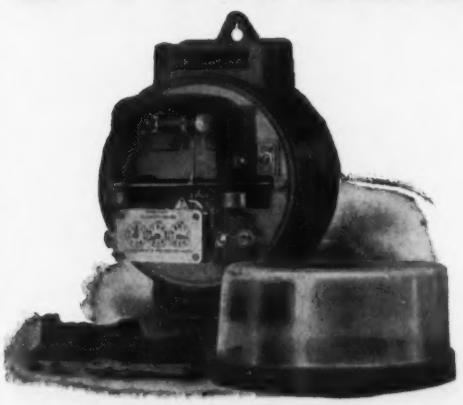

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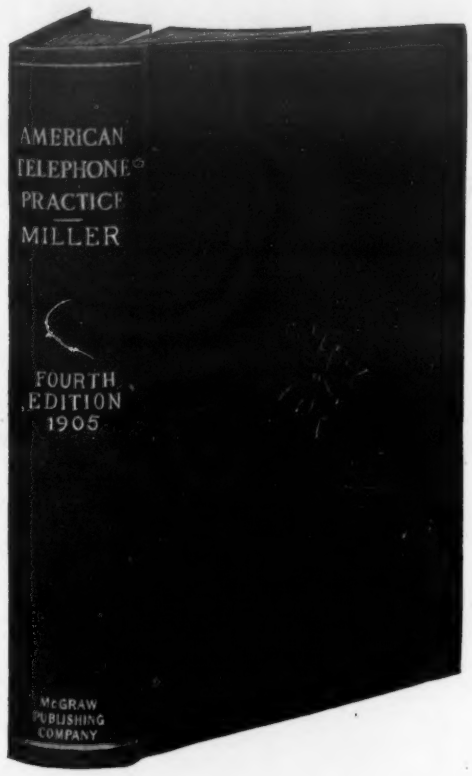

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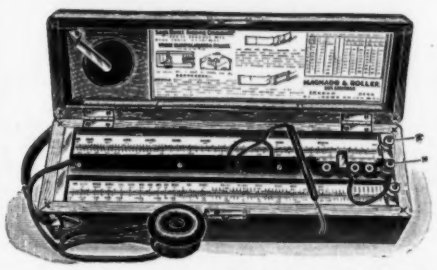

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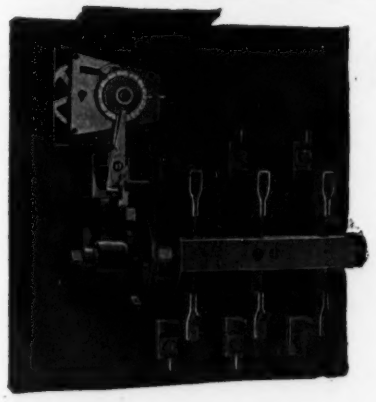

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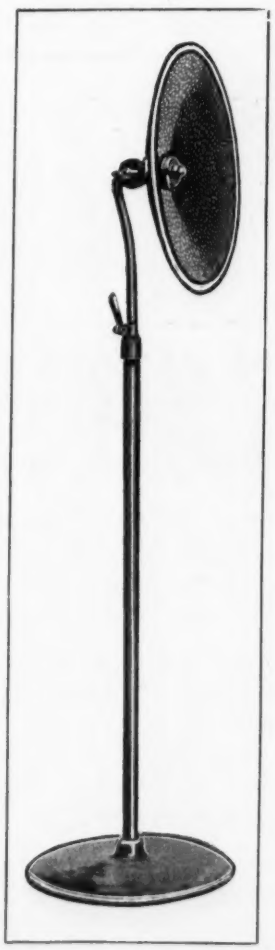

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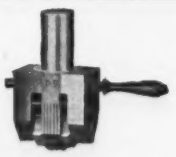

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Southern Exchange Co.
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Meyrowitz, E. B.

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Warner Instrument Co.

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Pass & Seymour, Inc.
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Manhattan Dial Co.

DISCS, ARMATURE.
Wilson & Smith.

DRILLS (Electric).
Chicago Pneumatic Tool Co.

DRILL GRINDERS.
Morse Twist Drill & Machine Co.
Pratt & Whitney Co.

DRILLS, PORTABLE.
Stow Mfg. Co.

DRILLS, ROCK.
Jeffrey Mfg. Co.
Northern Electrical Mfg. Co.

DYNAMOS, ELECTROPLATING.
Bogue, C. J.
Conn. Dynamo & Motor Co.

DYNAMOS AND MOTORS.
Aaron Electric Co.
Allgemeine Elektricitäts Gesellschaft.
Allis-Chalmers Co.
American Engine Co.
Bissell Co., F.
Bogue, C. J.
British Westinghouse Elec. & Mfg. Co.
British Thomson-Houston Co.
Brush Elec'l Engineering Co.
Bullock Elec. Mfg. Co.
Burke Electric Co.
C. & C. Electric Co.
Century Electric Co.
Commercial Electric Co.
Conn. Dynamo & Motor Co.
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Crocker-Wheeler Co.
Dick, Kerr & Co.
Diehl Mfg. Co.
Eck Dynamo & Motor Works.
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Electro-Dynamic Co.
Elektron Mfg. Co.
Elwell-Parker Elec. Co.
Emerson Electric Mfg. Co.
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Fuller Co.
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Gregory Electric Co.
Holtzer-Cabot Electric Co.
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Keystone Electric Co.
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Lincoln Electric Co.
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New England Motor Co.
Northern Electrical Mfg. Co.
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Robbins & Myers Co.
Rossiter, McGovern & Co.
Rushmore Dynamo Works.
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Stanley-G. I. Elec. Mfg. Co.
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Sturtevant Co., B. F.
Thompson, Jr., Jos. H.
Thompson-Bonney Co.
Triumph Elec. Co.
Wagner Elec. Mfg. Co.
Warren Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.
Williams Elec. Mch. Co.

ECONOMIZERS, FUEL.
Green Fuel Economizer Co.
Sturtevant Co., B. F.

ELECTROMAGNETS.
Devine, J. P.
Splitdorf, C. F.
Underhill, Charles R.

ELEVATORS.
Jeffrey Mfg. Co.
Link-Belt Engineering Co.

ENGINEERS, CONSULTING.
Bailey, Fred W. C.
Baker & Co., W. E.
Barstow, W. S.
Bates & Neilson.
Beadle & Maxwell.
Byllesby & Co., H. M.
Carman & Co., Chas. Whitney.
Cason & Barrett.
Cornell, T. S.
Corson, Wm. R. C.
Cory, Meredith & Allen.
Cudworth, Axtell & Co.
Dodge & Day.
Foster, Horatio A.
Hanchett, Geo. T.
Horry, Wm. Smith.
Hoxie, George L.
Humphrey, Henry H.
Jackson, Dugald C.
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Lansingh, Van Rensselaer.
Mailloux, C. O.
Masson, R. S.
Mershon, Ralph D.
Palmer, W. K.
Pierce, Richardson & Neiler.
Porter, Albert B.
Reckenzaun, Fred'k.
Sargent & Lundy.
Sheaff & Jaastad.
Stanton, Leroy W.
Wagner, Herbert A.

ENGINEERS, CONTRACTING.
American Bridge Co.
Arnold Co.
Bean, Irving McC.
Doble Co., Abner.
Electrical Equipment & Supply Co.
Forbes Co., W. D.
Ford Bacon & Davis.
Fuller Co.
Gest, G. M.
Gherky, W. D.
Heck, Louis.
Hewitt & Co., C. E.
Horry, Wm. Smith.
Iron City Engineering Co.
Kelly Engineering Co., John F.
Kilbourne & Clark Co.
Kohler Bros.
Pepper & Register.
Richardson Engineering Co.
Sanderson & Porter.
Schott, W. H.
Stanley-G. I. Elec. Mfg. Co.
Thompson, M. T.
Westinghouse, Church, Kerr & Co.
White & Company, J. G.

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Allis-Chalmers Co.
Carlisle & Finch Co.
Jones Co., S. M.
Marinette Gas Engine Co.
Otto Gas Engine Works.
Parsell & Weed.
Power & Mining Machinery Co.
Westinghouse Machine Co.
Wood & Co., R. D.

ENGINE OIL.
Marine Engine & Mch. Co.

ENGINES, STEAM.
Allgemeine Elektricitäts Gesellschaft.
Allis-Chalmers Co.
American Blower Co.
American Engine Co.
Atlas Engine Works.
Ball & Wood Co.
Ball Engine Co.
British Westinghouse Elec. & Mfg. Co.
Brush Elec'l Engineering Co.
Buckeye Engine Co.
Cooley Gen'l Development Co.
Dick, Kerr & Co.
Erie Mfg. & Supply Co.
Forbes Co., W. D.
Frick Co. (Corliss and Automatic).
Fuller Co.
Hooven, Owens, Rentschler Co.
Harrisburg Foundry & Mch. Works.
Ide & Sons, A. L.
Marine Engine & Mch. Co.
McIntosh, Seymour & Co.
Morris Company, I. P.
Providence Engineering Works.
Reeves Engine Co.
Ridgway Dynamo & Engine Co.
Rochester Mch. Tool Works.
Shepherd Engineering Co.
Skinner Engine Co.
Southwark Foundry & Mach. Co.
Station Equipment Co.
Sturtevant Co., B. F.
Thompson, Jr., Jos. H.
Thompson-Bonney Co.
U. S. Rapid-Fire Gun & Powder Co.
Valley Iron Works.
Vilter Mfg. Co.
Watertown Engine Co.
Westinghouse Machine Co.
Wetherill & Co., Robt.

ENGINE STOPS.
Consolidated Engine Stop Co.

EXHAUST HEADS.
Burt Mfg. Co.

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Baillard, E. V.

FANS AND MOTORS.
American Blower Co.
British Thomson-Houston Co.
Central Elec. Co.
Dayton Fan & Motor Co.
Diehl Mfg. Co.
Doubleday-Hill Elec. Co.
Eck Dynamo & Motor Works.
Electric Motor & Equipment Co.
Electrical Equipment & Supply Co.
Emerson Elec. Mfg. Co.
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Holtzer-Cabot Elec. Co.
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American Blower Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Emerson Electric Mfg. Co.
Fuller Co.
Green Fuel Economizer Co.
Mechanical Appliance Co.
Sturtevant Co., B. F.

FILES, RASPS, ETC.
Barnett & Co., G. H.

FIXTURES, GAS AND ELECTRIC.
Benjamin Elec. Mfg. Co.
Dale Co.
Federal Electric Co.
Kilbourne & Clark Co.
McMeen & Miller.

FLASHERS.
Electric Motor & Equipment Co.
Haller Machine Co.
Reynolds Elec. Flasher Mfg. Co.

FLEXIBLE SHAFTS.
Stow Mfg. Co.

FORGES.
Sturtevant Co., B. F.

FUSES.
American Electric Fuse Co.
Brush Elec'l Engineering Co.
Central Electric Co.
Chase-Shawmut Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Co.
Johns-Manville Co., H. W.

GAUGES, STEAM.
Lunkenheimer Co.

GAS LIGHTING APPARATUS.
Ostrander & Co., W. R.
Splitdorf, C. F.

GLASS.
Gillender & Sons, Inc.
Phoenix Glass Co.

GLASS TUBES.
Phoenix Glass Co.

GLOBES, ARC LAMP.
Gillender & Sons, Inc.
Phoenix Glass Co.

GLOBES, SHADES, ETC.
American Reflector & Lighting Co.
Dale Co.
Frink, I. P.
Gillender & Sons, Inc.
Phoenix Glass Co.
Tea Tray Co.

GEARS.
New Process Rawhide Co.
Simplex Railway Appliance Co.
Smith Co., S. Morgan.

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Dixon Crucible Co., Jos.

GRATES.
American Stoker Co.

GREASE.
Dixon Crucible Co., Jos.

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HANGERS, CABLE.
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Johns-Manville Co., H. W.
Standard Underground Cable Co.
Star Expansion Bolt Co.
Yonkers Specialty Co.

HEATERS, FEEDWATER.
Erie Mfg. & Supply Co.
Platt Iron Works Co.

HEATING APPARATUS.
American Blower Co.
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HEATING DEVICES, ELECTRIC.
American Electrical Heater Co.
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Kilbourne & Clark Co.
Simplex Electric Heating Co.

HEATING BY EXHAUST STEAM.
American District Steam Co.
Schott, W. H.

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Case Mfg. Co.
Dodge Coal Storage Co.
Jeffrey Mfg. Co.
Mead-Morrison Mfg. Co.
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Sprague Electric Co.
United Telpherage Department.
Yale & Towne Mfg. Co.

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Pelton Water Wheel Co.

ICE-MAKING MACHINERY.
Automatic Refrigerating Co.
Frick Co.
Vilter Mfg. Co.

IGNITERS, GAS ENGINE.
Carlisle & Finch Co.
Holtzer-Cabot Elec. Co.

IMPREGNATING APPARATUS.
Devine, J. P.

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Atwater-Kent Mfg. Co.
Baillard, E. V.
Biddle, James G.
Bristol Co.
Cutter Elec'l & Mfg. Co.
Diamond Meter Company.
Dongan Instrument Co.
Duncan Elec. Mfg. Co.
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Eldredge Elec. Mfg. Co

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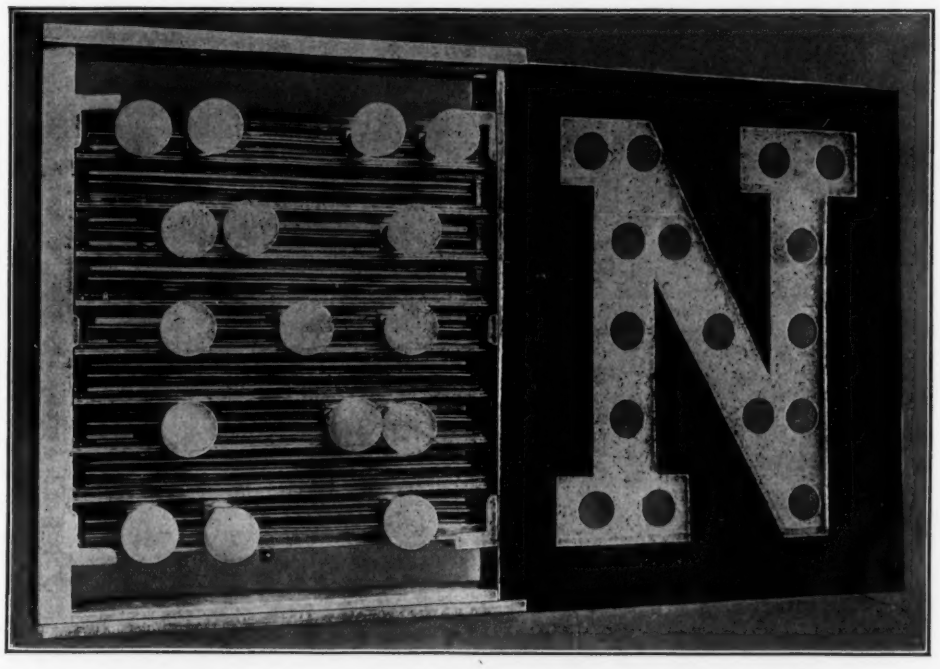

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Richard, Jules.
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Schaeffer & Budenberg.
Simplex Company.
Stanley-G. I. Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Elec. Mfg. Co.
Westinghouse Electric & Mfg. Co.
Whitney Electric Inst. Co.

INSULATING MATERIAL, CEMENT.
Insulatine Co.

INSULATING MATERIAL, CHINA AND PORCELAIN.
Anderson Mfg. Co., A. & J. M.
Empire China Works.
Hartford Faience Co.
Imperial Porcelain Works.
Lima Insulator Co.
Locke Insulator Mfg. Co.
Pass & Seymour, Inc.
Sears, Henry D.
Star Porcelain Works.

INSULATING MATERIAL, COMPOUNDS, PAINTS AND VARNISHES.
Macon-Evans Varnish Co.
Mica Insulator Co.
Munsel & Co., Eugene.
Standard Paint Co.
Standard Underground Cable Co.
Standard Varnish Works.
Sterling Varnish Co.

INSULATING MATERIAL, COMPOSITION, CLOTH AND PAPER.
Hope Webbing Co.
Insulatine Co.
Johns-Manville Co., H. W.
Johns-Pratt Co.
Mica Insulator Co.
Standard Undergrouid Cable Co.

INSULATING MATERIAL, FIBRE.
American Vulcanized Fibre Co.
Delaware Hard Fibre Co.
Diamond State Fibre Co.
Kartavert Mfg. Co.
Morris Electric Co.
Vulcanizer Fibre Co.
Wilmington Fibre Specialty Co.

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Kruesi, P. J.
Steward Mfg. Co., D. M.

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Mica Insulator Co.
Munsell & Co., Eugene.
Vance, D. T.

INSULATING MATERIAL, SILK.
Ryle & Co., Wm.
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INSULATING MATERIAL, STAPLES.
Blake Signal & Mfg. Co.

INSULATING MATERIAL, TAPE.
American Electrical Works.
Electric Appliance Co.
Hope Webbing Co.
Mica Insulator Co.
Morgan & Wright.
New York Insulated Wire Co.
Okonite Co., Ltd.
Standard Underground Cable Co.

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Anderson Mfg. Co., A. & J. M.
Empire China Works.
Imperial Porcelain Wks.
Johns-Manville Co., H. W.
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Locke Insulator Mfg. Co.
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Star Porcelain Works.
Steward Mfg. Co., D. M.

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Locke Insulator Mfg. Co.

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Smith, Hemenway & Co., Corp.
Watson-Stillman Co.

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Incan. Electric Lt. Manip. Co.

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Dwyer Machine Co.

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Allgemeine Elektricitäts Gesellschaft.
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Bissell & Co., F.
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General Electric Co.
Gregory Electric Co.
Jandus Electric Co.
Stanley-G. I. Elec. Mfg. Co.
Universal Electrical Wks.
Warner Arc Lamp Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

LAMP CLEANERS, INC.
Incan. Electric Lt. Manip. Co.

LAMP HOLDERS.
Crescent Co.

LAMPS, INCANDESCENT.
Banner Electric Co.
Bissell Co., F.
British Thomson-Houston Co.
Brush Elec'l Engineering Co.
Buckeye Electric Co.
Central Electric Co.
Columbia Inc. Lamp Co.
Downward Light Elec. Co.
Dwyer Machine Co.
Edison Dec. & Min. Lamp Co.
General Electric Co.
Machado & Roller.
Missouri American Elec. Co.
New York & Ohio Co.
Phelps Co.
Sawyer-Man Electric Co.
Shelby Electric Co.
Standard Electrical Mfg. Co.
Sunbeam Inc. Lamp Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

LAMPS, MINIATURE.
American Endoscopic Co.
Boehm & Co., H.
Edison Dec. & Min. Lamp Co.
Jaeger Min. Lamp Co.

LAMP REPLACERS.
Incan. Electric Lt. Manip. Co.

LAMPS, TURNDOWN.
Phelps Company.

LAMPS, VAPOR.
Cooper Hewitt Elec. Co.

LATHES.
Barnes Co., W. F. & John.
Niles-Bement-Pond Co.
Sebastian Lathe Co.
Seneca Falls Mfg. Co.

LAUNCHES, ELECTRIC.
Electric Launch Co.

LIGHTNING ARRESTERS.
D. & W. Fuse Co.
Garton-Daniels Co.
Stanley-G. I. Elec. Mfg. Co.
Viaduct Mfg. Co.
Westinghouse Elec. Mfg. Co.

LOCKERS.
Merritt & Co.

LOCOMOTIVES, ELECTRIC MINE
Jeffrey Mfg. Co.

LUBRICATORS.
Crane Co.
Lunkenheimer Co.

MACHINE TOOLS, ETC.
Barnes Co., W. F. & John.
Garvin Mch. Co.
Niles-Bement-Pond Co.
Pratt & Whitney Co.
Sebastian Lathe Co.
Seneca Falls Mfg. Co.
Watson-Stillman Co.

MAGNETS, LIFTING.
Electric Controller & Supply Co.
Williams Elec. Mch. Co.

MARINE ELECTRIC EQUIPMENT.
Garrett, Miller & Co.
Electro-Dynamic Co.
Kilbourne & Clark Co.
Russell & Stoll Co.

MAST ARMS.
Brady, T. H.

MECHANICAL DRAFT.
American Blower Co.
Green Fuel Economizer Co.

MEDICAL APPARATUS.
Pignolet, Louis M.
Splitdorf, C. F.

METALS.
American Platinum Works.
Baker & Co., Inc.
Croselmire & Ackor.
Leslie & Co., A. C.
Phosphor Bronze Smelting Co.

METAL POLISH.
Allen Co., Inc., L. B.
Hoffman, George W.

MILLING MACHINES.
Garvin Machine Co.
Niles-Bement-Pond Co.
Pratt & Whitney Co.

MINING MACHINERY.
General Electric Co.
Jeffrey Mfg. Co.
Muralt & Co.
Power & Mining Machinery Co.

MODEL MAKERS.
Baillard, E. V.
International Brass & Elec. Co., Inc.
Parsell & Weed.

MOULDING BRANCH BLOCKS.
Elm City Engineering Co.

NAPHTHA.
Barrett Mfg. Co.

NIPPERS AND PLIERS.
Cincinnati Tool Co.
Smith, Hemenway & Co., Corp.
Utica Drop Forge & Tool Co.

NOVELTIES, ELECTRIC.
American Endoscopic Co.
Carlisle & Finch Co.
Cornwell Co., R. M.
Roche, William.

NOZZLES.
Doble Co., Abner.
McCullough-Dalzell Crucible Co.
Pelton Water Wheel Co.

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National Acme Mfg. Co.

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Crane Co.
Lunkenheimer Co.

OIL, CYLINDER.
Kellogg & Co., E. H.

OIL FILTERS AND PURIFIERS.
Burt Mfg. Co.

PACKING.
Jenkins Bros.
Johns-Manville Co., H. W.
Peerless Rubber Mfg. Co.

PATENT ATTORNEYS.
Dunn & Turk.
Dyer & Dyer.
Goepel & Goepel.
Johnston, Frank K.
Rosenbaum & Stockbridge.
Shepard & Parker.
Townsend & Decker.

PHOTOMETERS.
Dwyer Machine Co.
Electric Motor & Equipment Co.

PHOTOMETER STANDARDS.
Electrical Testing Laboratories.

PHOSPHOR BRONZE.
Phosphor Bronze Smelting Co.

PINIONS, RAWHIDE.
New Process Rawhide Co.

PINS, STEEL.
Locke Insulator Mfg. Co.

PLATINUM.
American Platinum Works.
Baker & Co., Inc.
Croselmire & Ackor.

PLUGS.
Keough Bros. & Co.
Paiste Co., H. T.

POLES, ARC LAMP.
Mott Iron Wks., J. L.

POLES, BRACKETS, PINS, ETC.
Bissell Co., F.
Brady, T. H.
Eccleston Lumber Co.
Kellogg Switchboard & Supply Co.
Lindsley Bros. & Co.
Maus & Co., H. H.
Phelan, D. W.
Porter Cedar Co.
Sand Point Cedar Co.
Southern Exchange Co.
Sterling & Son, W. C.
Strock, S. C.
Valentine-Clark Co.
Whitmore, A. E.
Worcester Co., C. H.

POWER TRANSMISSION MACHINERY.
Case Mfg. Co.
Hunter Machine Co., James.
Jeffrey Mfg. Co.
Link-Belt Engineering Co.
Mead-Morrison Mfg. Co.
Niles-Bement-Pond Co.

PRESSES, DIES AND SPECIAL MACHINERY.
Hunter Machine Co., James.
Niles-Bement-Pond Co.
Watson-Stillman Co.

PULLEYS, SHAFTING, COUPLINGS, ETC.
Hunter Machine Co., James.
Jeffrey Mfg. Co.
Niles-Bement-Pond Co.
Smith Co., S. Morgan.

PUMPS, ELECTRIC.
Conover Condenser Co.
Commercial Electric Co.
De Laval Steam Turbine Co.
Emerson Elec. Mfg. Co.
Quimby, Wm. E.
Watson Machine Co.
Worthington, Henry R.

PUMPS, OIL.
Lunkenheimer Co.

PUMPS, STEAM.
De Laval Steam Turbine Co.
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Morris Company, I. J.
Quimby, Wm. E.
Worthington, Henry R.

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Alberger Condenser Co.
Hubbard's Sons, Norman.
Pulsometer Engineering Co.

PUNCHES AND SHEARS.
Long & Allstatter Co.
Niles-Bement-Pond Co.
Pratt & Whitney Co.

PUSH BUTTONS.
Edmonstone Co.

RAIL BONDS.
Chase-Shawmut Co.
Roebling's Sons Co., J. A.

RAILWAYS, MINIATURE.
Carlisle & Finch Co.

RECEPTACLES.
Benjamin Elec. Mfg. Co.
Electro-Dynamic Co.
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Russell & Stoll Co.

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Platt Iron Works Co.

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American Reflector & Lighting Co.
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Phoenix Glass Co.
Sarco Company.
Sunlight Reflector Co.

REFRIGERATING MACHINERY.
Automatic Refrigerating Co.
Vilter Mfg. Co.

REPAIRING.
Chicago Edison Co.
Elliott Bros. Elec. Co.
Gregory Electric Co.
Heck, Louis.
Waterbury & Co.

RESISTANCE UNITS.
Electric Controller & Supply Co
Simplex Electric Heating Co.
Ward Leonard Elec. Co.

RHEOSTATS.
American Electric & Controller Co.
Automatic Switch Co.
Cutler-Hammer Mfg. Co.
Globe Elec. Controller Co.
Simplex Electric Heating Co.
Ward Leonard Electric Co.
Wirt Electric Co.

ROSETTES.
Hart Mfg. Co.
Paiste Co., H. T.
Pass & Seymour, Inc.
Sears, Henry D.
Yost Elec. Mfg. Co.

SAL AMMONIAC.
Allen Co., L. B.
Klipstein & Co., A.
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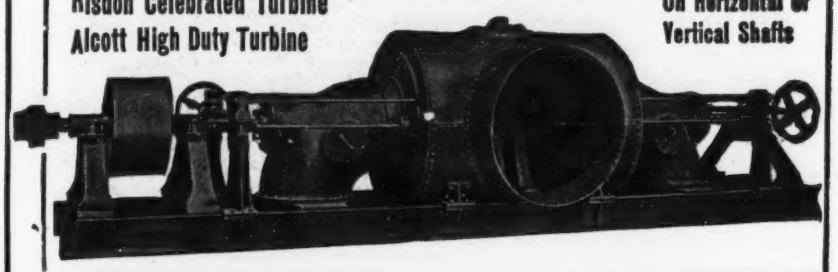

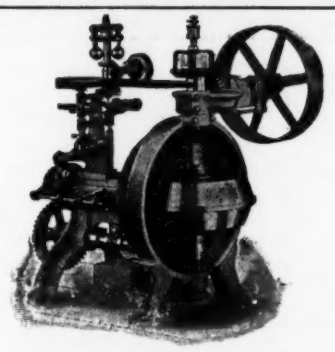

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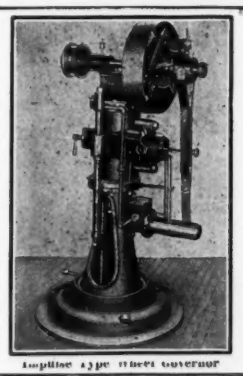

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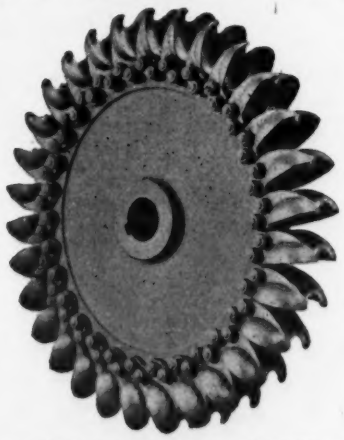

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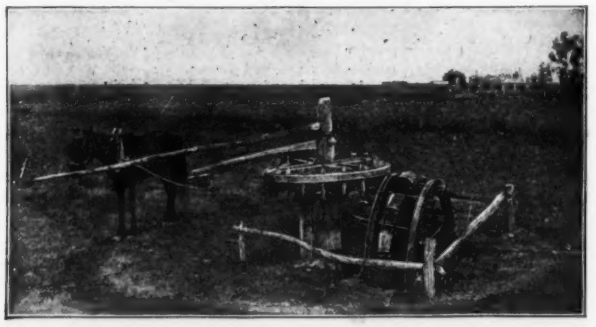

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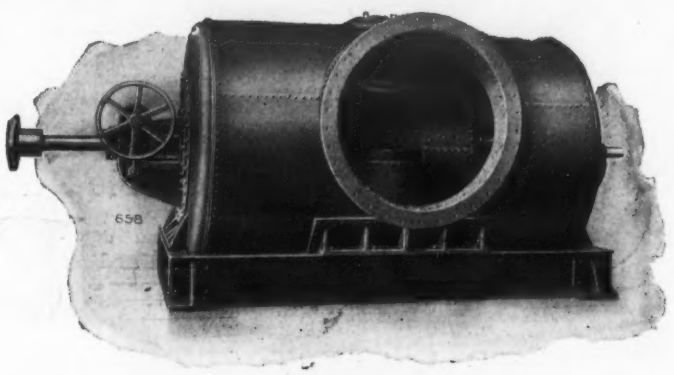

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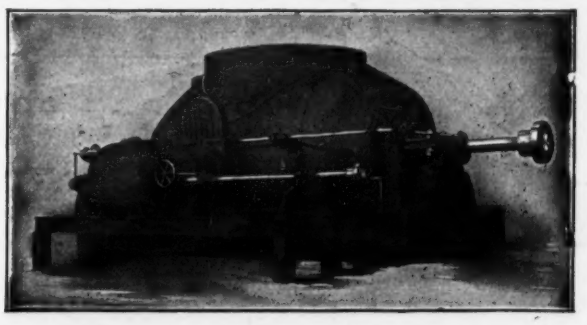

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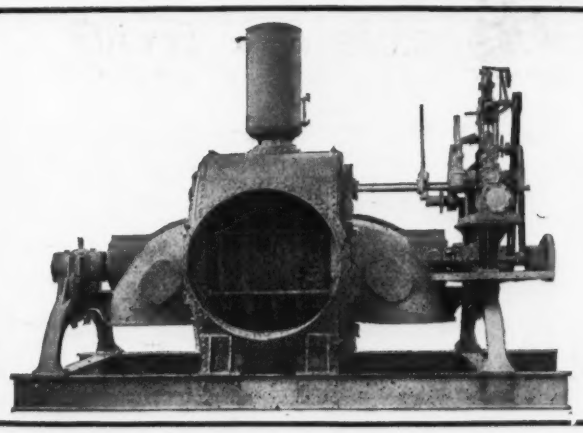

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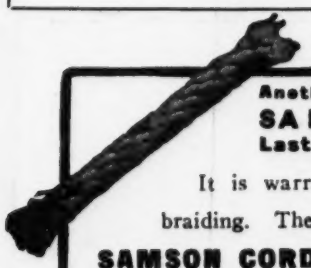

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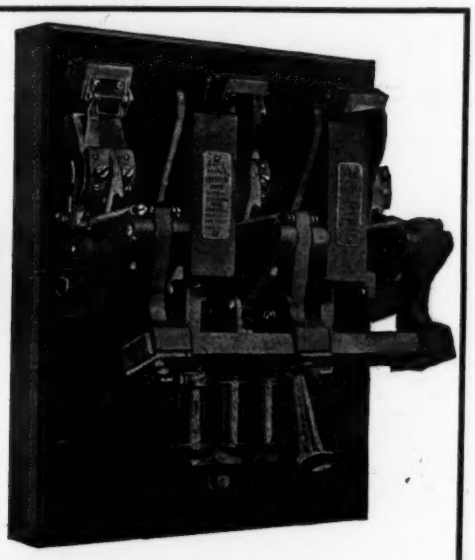

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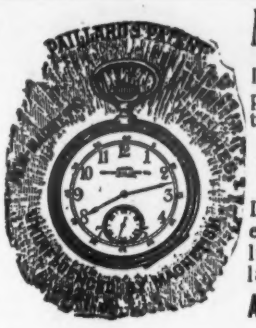

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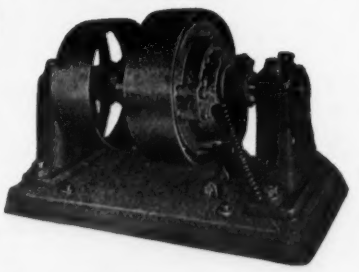

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Williams Electric Machine Co.
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PURE COAL TAR
BENZOLS and NAPHTHAS
For Electrical Purposes
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KARTAVERT.
HARD AND FLEXIBLE FIBRE IN SHEETS, RODS AND TUBING.
For Electrical and Mechanical Purposes, Railway Dust Guards, Washers and Packings. Patent Insulating Cleats.
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Every System—Repairing, Re-winding, Re-construction
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POSITIONS WANTED

The rate for "Position Wanted" advertisements of forty words or less is one dollar an insertion; additional words two cents each, payable in advance. Remittance and copy should reach this office not later than Tuesday morning for the next succeeding issue.

POSITION WANTED.—As manager or superintendent of an electric light or street railway property; thorough experience in construction and operation in detail; best of references; capable of handling any size property. Address W. H. P., care Electrical World and Engineer, Chicago, Ill.

POSITION WANTED.—By a steam electrical engineer, as superintendent for small light and power company; a first-class mechanic; have fine tools including lathe, indicator and electrical testing instruments; would like to take stock in company; sixteen years' experience installing and operating steam power plant; age 30; married; can make a poor plant pay. Address No. 2043, care Electrical World and Engineer, New York.

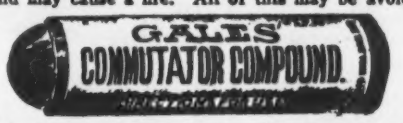
POSITION WANTED.—In light or power plant; ten years' experience; can do all electrical work, can operate and care for engines and dynamos; fine recommendations; wish to locate permanently. Address No. 2109, care Electrical World and Engineer, New York.

POSITION WANTED

As manager, superintendent, chief engineer or salesman of company of importance, by graduate electrical and mechanical engineer; 30 years old, 7 years experience, machinist by trade, thoroughly familiar with all classes of steam, electric, air and pumping machinery, in design, construction and operation of commercial and manufacturing power plants, long distance transmission, street railway and lighting, underground work a specialty. Holds good position now. Excellent references from all former employers. Good reasons for wishing to make a change. Address No. 2115, care Electrical World and Engineer.

SPARKING

reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All of this may be avoided if you use



The only article that will prevent sparking. Will keep the commutator in good condition and prevent cutting. Absolutely will not gum the brushes.

It will put that high gloss on the commutator you have so long sought after

Send for Stick. 50c. PER STICK. $5.00 PER DOZEN.

FOR SALE BY ALL SUPPLY HOUSES OR **K. McLENNAN & CO.,** SOLE MANUFACTURERS. (2)

Room 411, 130 Dearborn St., CHICAGO

IF YOU WANT AN ARTICLE THAT WILL REPEAT ITSELF,

TRY **U. S. METAL POLISH**

Highest Award, Chicago World's Fair, 1893. Louisiana Purchase Exposition, St. Louis, 1904.

Sold by Dealers. Samples Free.

Geo. W. Hoffman, MANUFACTURER, 296 E. Washington St., Indianapolis, Ind.

FOR POLISHING ALL KINDS OF METALS.

POSITION WANTED.—Electrical engineer, 33; technical graduate; eleven years' experience, including drafting; central station design, installation and operation; designing and manufacturing d.c. generators and special controlling apparatus; as consulting engineer, and in executive capacities; desires change. Excellent record and references. Address No. 2114, care Electrical World and Engineer, New York.

ELECTRICAL WORLD and ENGINEER

is more widely quoted abroad than any other electrical journal published

HELP WANTED

The rate for Help Wanted advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittance and copy should reach this office not later than Tuesday morning for the next succeeding issue.

WANTED.—Draftsman on switchboards and panels; must have some experience in mechanical drawing, also for manufacturing plant; good future; one able to handle correspondence preferred. Address No. 2094, care Eelectrical World and Engineer, New York.

WANTED.—Experienced solicitors and canvassers in the securing of electric light and power business; give references, experience and salary expected. Wilkesbarre Gas & Electric Co., Wilkesbarre, Pa.

WANTED.—At once, several A1 draftsmen. Apply to engineer in charge, Drafting Dept., General Electric Company, Schenectady, N. Y.

WANTED.—Technical man in every town; no goods to sell; no expense; those appointed so far are professors, members A. I. E. E. and A. S. M. E., literary draughtsmen, etc.; no conflict with regular business. Address No. 2045, care Electrical World and Engineer, New York.

WANTED.—Four draftsmen on construction work; must have had at least three years' experience; steady employment; state age, experience and salary expected. Address No. 2112, care Electrical World and Engineer, New York.

WANTED.—Two draftsmen, experienced on telephone apparatus. State age, education and experience, or call in person. Address Western Electric Company, 242 South Jefferson St., Chicago, Ill.

WANTED.—A good, all-around electrician and lineman, who can read meters and install the same, and has had experience on 1,100-volt, single-phase line work. Wages, $50 per month to start with, extra pay for Sundays. Address with references P. O. Box 228, Chambersburg, Pa.

WANTED.—Electrical and hydraulic expert to take charge of an electrical power proposition; must have good address. Address No. 2110, care Electrical World and Engineer, New York.

WANTED.—Experienced draftsmen in electrical apparatus, switchboards, transformers, motors and generators; only first-class men need apply; state experience and salary expected. Address No. 2113, care Electrical World and Engineer, New York.

WANTED.—A good, all-around electrician and lineman who can read meters, trim arc lamps, and has had experience on high-tension line work; forward references to the Shore Electric Company, 37 East Front Street, Red Bank, N. J.

If you want to do business with any man in the electrical field in any part of the world the right medium to advertise in is ELECTRICAL WORLD AND ENGINEER.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO.

Send for our Monthly Bargain Sheet showing NET prices—all machines fully guaranteed and actually in stock

ALTERNATORS—60 CYCLES

Lights.		
1	180	Thomson-Houston, 9 K. W.
1	450	Westinghouse, 22½ K. W.
3	900	Westinghouse, 45 K. W.
1	1200	Westinghouse, 60 K. W.
1	1500	Warren-Medberry, 75 K. W., 2 phase, inductor.
1	1500	Westinghouse, 75 K. W.
1	1500	Westinghouse, 75 K. W., comp., 2 phase.
1	1500	Westinghouse, 75 K. W., two phase, direct connected to 14x14 Gates self-oiling, 4-valve automatic engine.
1	1800	Gen. Elec., 90 K. W.
2	3000	Warren, 150 K. W., Inductor type.
1	3600	Stanley, 180 K. W., 2 phase, Inductor type.
1	4500	Westinghouse, 225 K. W., 2 phase.

125 TO 133 CYCLES

Lights.		
1	350	T.-H., A 18.
1	1200	Westinghouse, 60 K. W.
3	1200	Gen. Elec., A. 60.
1	1500	Wood, 75 K. W.
1	2000	Gen. Elec., A. 100.
2	2400	Gen. Elec., 120 K. W.
1	2400	Gen. Elec., 120 K. W., type A. S.
1	3000	Stanley, inductor type, 150 K. W., 2 phase.

250 VOLT GENERATORS

K. W.		
1	7½	Holtzer-Cabot.
1	9	New England, M. P.
1	9	Crocker-Wheeler, M. P.
1	12	Western Elec., M. P.
1	17½	Kester.
1	17½	Eddy.
1	17½	Western Elec., M. P.
1	20	Edison.
2	22½	Westinghouse, M. P.
1	25	Crescent, M. P.
2	35	Bernard, M. P.
2	35	Western Elec., M. P.
1	40	E. & C., multipolar.
2	45	Am. Eng. Co., M. P.
1	50	C. & C.
1	50	Maine, M. P.
1	55	Fuller, multipolar.
1	75	Siemens & Halske, Churchward type, M. P., brand new, for direct connection.
1	123	Eddy, M. P.

K.W.		
2	150	National, M. P.
2	200	Eddy, multipolar.
1	300	Western Electric, M. P., brand new, 8 pole, 3 bearing.

550 VOLT GENERATORS

K.W.		
1	45	Edison, new armature.
1	60	Edison, new armt. and com't.
1	62	T.-H., D 62.
1	100	Siemens & Halske, M. P.
2	100	Edison, comp., new armt.
1	200	Thompson-Ryan, M. P.
1	200	Gen. Elec., s-o.

125 VOLT GENERATORS

Lights.		
3	10	Towle, M. P.
1	18	Western Electric.
1	20	Northern, M. P.
2	25	Sprague-Lundell.
1	30	Westinghouse, M. P.
2	35	T.-H., type D 1½.
1	35	Westinghouse.
1	35	Browning.
1	35	Hobart, M. P.
5	40	Browning.
2	40	Wood.
1	40	Roth, M. P., direct connected.
1	50	Browning, M. P., new.
1	50	Gen. Elec., M. P., direct connected.
1	60	Westinghouse.
1	60	Western Elec., type G.
2	60	Browning.
2	60	Hobart, M. P.
1	65	Gen. Elec., type C. E.
5	65	Browning, M. P.
1	75	Gen. Elec., type I. B.
1	75	Westinghouse, M. P.
1	75	Phoenix, direct connected.
1	80	Card, multipolar.
2	80	Browning, M. P.

Lights.		
5	80	Hobart, M. P.
1	90	Browning, M. P.
2	100	Hobart, M. P.
1	100	Triumph, M. P.
3	110	New Eng., M. P.
1	110	Akron, M. P.
1	110	Browning, M. P.
2	110	Commercial, M. P.
1	140	Bernard.
1	150	Keystone, M. P.
1	165	Amer. Eng. Co., M. P.
1	175	Eddy, M. P.
1	200	Western Electric.
1	210	C. & C.
1	210	Eddy, M. P.
1	225	Western Elec., M. P.
1	270	King.
1	270	T.-H., D 15.
2	300	Jenney.
4	300	Western Elec., M. P.
1	350	T.-H. type D 20.
1	350	Edison, 20 K. W.
1	350	C. & C., M. P.
1	350	Card, M. P.
1	360	Holtzer-Cabot.
1	360	Western Elec., M. P.
1	400	Westinghouse, M. P.
1	450	Edison, 25 K. W.
2	450	Commercial, M. P.
1	450	Bullock, M. P.
2	450	Sprague-Lundell, M. P.
1	450	Quaker City, M. P.
2	450	Eddy, M. P.
2	450	Gen. Elec., M. P.
3	450	West. Elec., M. P.
1	500	Jenney, 30 K. W.
2	540	Edison, 30 K. W.
1	540	Fisher, M. P.
1	540	Akron, M. P.
1	540	C. & C., M. P., 30 K. W.
1	540	Elwell-Parker, M. P.
1	540	G. E., M. P., 30 K. W.

Lights.		
1	540	Westinghouse, M. P.
1	600	Muncie.
3	600	Card, M. P.
1	600	G. E., M. P., 35 K. W.
1	650	Excelsior, M. P., 37½ K. W.
1	650	Milwaukee, M. P., 37½ K.W.
1	650	Westinghouse, M. P.
2	700	Commercial, M. P.
1	700	Card, M. P.
1	700	Crocker-Wheeler, M. P.
2	800	Gen. Elec., M. P.
1	900	Wagner, M. P., 50 K. W.
1	950	Crocker-Wheeler, M. P.
1	1000	Gen. Elec., direct connected.
1	1100	Triumph, M. P., 65 K. W.
1	1300	Card, M. P., 75 K. W.
2	1300	Western Elec., M.P., 75 K.W.
1	1350	Waddel-Entz, 80 K. W., d. c.
2	1350	Gen. Elec., M. P., 75 K. W., direct connected.
1	1450	Gen. Elec., M. P., 85 K. W.
2	1800	Edison, 100 K. W.
1	1800	Western Elec., M. P., 100 K. W.
1	2500	Western Electric, M. P., comp., for direct connection, brand new, 150 K. W.

110 VOLT MOTORS

H. P.		
1	½	Keystone, M. P.
1	½	Crocker-Wheeler.
1	½	Keystone, M. P.
1	¾	Diehl.
2	1	Browning.
1	1	New England.
1	1¼	Northern, M. P.
1	1¼	Western Electric.
3	1½	Sprague-Lundell.
2	2	Browning, new.
1	2	Westinghouse, M. P.
2	2½	Wood.
1	2½	Hobart, M. P.
5	2½	Browning.
1	3	Browning, M. P.
2	3½	Browning.
1	3½	Western Elec.
2	4	Hobart, multipolar.
3	4	Browning, M. P.
1	4½	Gen. Elec.
1	5	Gen. Elec.
2	5	Browning, M. P.
3	5	Hobart, M. P.
1	5	Card.
2	5	Browning, M. P.
1	6	Browning, M. P.
1	6	Westinghouse, M. P.
2	7½	New England, M. P.

CHARLES E. DUSTIN COMPANY,

ELECTRICAL AND STEAM MACHINERY

11 BROADWAY, NEW YORK

Multiphase 60 Cycle Alternators

600 Kw. Westinghouse, 2,400 volts; two-phase; 22 poles, 330 R.P.M., for connection to water wheel.

400 Kw. General Electric, 2,300 volts; three-phase; 360 R.P.M. Revolving field. Type, A.T.B. Class, 20-400-360. Form, B.

250 Kw. General Electric, 10,000 volts; three-phase; 450 R.P.M. Revolving field Type, A.T.B. Class, 16-250-450. Form, B, with switchboard.

150 Kw. Westinghouse, 2,200 volts; two-phase; 8 poles; 900 R.P.M. Revolving field. Practically brand new.

150 Kw. Westinghouse, 1,100 or 2,200 volts; two-phase; 12 poles; 600 R.P.M. Revolving armature. First-class condition.

100 Kw. General Electric, 1,100 volts; three-phase; 900 R.P.M. Revolving field. Type, A.T.B. Class, 8-100-900. Form, D. Excellent condition.

75 Kw. General Electric, 2,200 volts; two-phase; 900 R.P.M. Type, A.Q. Class, 8-75-900. Form, B. Very fine condition throughout.

75 Kw. Westinghouse, 220 volts; two-phase; 10 poles; 720 R.P.M. Composite wound.

60 Kw. Westinghouse, 1,100 or 2,200 volts; two-phase; 8 poles; 900 R.P.M. Newly rewound.

A large stock of Direct Current Apparatus, Engines and Boilers

New Factory and Storehouse, JERSEY CITY, N. J.

Twenty Minutes from New York.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO.

Send for our Monthly Bargain Sheet showing NET prices—all machines fully guaranteed and actually in stock.

220 VOLT MOTORS

H.P.		
4	½	Browning, new.
1	1	Diehl.
1	1	Towle, M. P.
3	1	New England.
3	1	Western Elec.
1	1	Browning.
1	1	Watson, M. P.
4	1½	Sprague-Lundell.
1	2	Cincinnati.
1	2	Towle.
1	2	Browning.
1	2	Maine, M. P.
1	2	Bernard, M. P.
1	2½	Browning.
1	3	Hartley, M. P.
1	3	Lundell.
1	3	Gibbs, multipolar.
1	3	Sprague-Lundell.
2	3	Westinghouse, M. P.
1	3½	Western Elec.
1	4	Commercial, M. P.
1	5	Gibbs, M. P.
1	5	General Electric, M. P.
2	5	Western Elec., M. P.
3	5	Browning, M. P.
1	5	Western Electric, enclosed.
1	5	Belknap, M. P.
2	5	Crocker-Wheeler, special printing press motors.
2	6	Riker.
1	7½	Eddy.
1	7½	C. & C.
1	7½	Milwaukee, M. P., series.
1	7½	Towle, M. P.
1	7½	New England, M. P.
1	8	Holtzer-Cabot.
1	8	Crocker-Wheeler, series.
1	8	Western Electric, M. P., direct connected to Eaton & Prince elevator, complete with controller and drum.
1	9½	Crocker-Wheeler, M. P.
1	10	New England, M. P.
1	10	C. & C., M. P.
1	10	Keystone, M. P.
1	10	Standard, M. P.
2	10	Bernard, M. P.
1	15	Eddy.
1	15	Keystone, M. P.
1	15	Western Elec., M. P.
1	20	Sprague.
1	20	Eddy.
1	20	Western Elec., M. P.
1	25	Edison.
1	30	Crescent, M. P.
2	30	Westinghouse, M. P.
2	40	Bernard, M. P.
2	40	Western Electric, M. P.

H. P.		
1	50	E. & C., multipolar.
2	50	Am. Engine Co., M. P.
1	60	C. & C.
1	60	Maine, M. P.
1	70	Fuller, multipolar.
1	150	Eddy, M. P.
2	200	National, M. P.

ELECTRIC MINING LOCOMOTIVES

Ton.	
1	10 Morgan-Gardner, type M, 250 v., direct current, double motor locomotive, 74 K. W., 42-inch gauge, speed 6 to 10 miles per hour.
1	17 Morgan-Gardner, type N, 250 v., direct current, double motor locomotive, 115 K. W., 40-in. gauge, speed 8 miles per hour.

500 VOLT MOTORS

H. P.		
3	¼	Browning.
1	½	Jenney.
2	½	Browning.
1	¾	Browning.
2	1	Browning.
1	1	Towle.
1	1	C. & C.
1	1	Holtzer-Cabot.
2	1	New England.
1	1	Lundell.
1	1	Holtzer-Cabot.
1	1	Browning.
1	1½	Northern, series.
1	1½	Belknap.
7	2	Browning.
5	3	Browning, M. P.
1	3	Westinghouse, M. P.
1	3	Jenney, M. P.
1	3½	Roth.
1	4	Fort Wayne.
1	4	New England.

H. P.		
1	4	Maine, M. P.
1	4	Bernard, M. P.
1	5	Card.
2	5	C. & C.
1	5	Browning, M. P.
1	6	Holtzer-Cabot.
1	6	Westinghouse, M. P.
3	7½	C. & C.
1	7½	Roth.
1	7½	Eddy, M. P.
1	10	Eddy.
1	10	C. & C.
1	10	New England.
1	10	Powell, M. P.
1	10	Northern, M. P.
1	10	Milwaukee, M. P.
2	10	Belknap, M. P.
1	12	Adams.
1	12	Holtzer-Cabot.
1	12	Amer. Eng. Co., M. P.
1	15	Eddy.
1	15	Perrett, M. P.
2	20	Bernard, M. P.
1	35	Card, M. P.
2	40	Wood, multipolar.
1	45	C. & C., M. P.
1	50	Eddy, M. P.
1	60	Edison.
1	65	Bullock, M. P.
1	75	T.-H., D 62.
1	75	Edison.
1	125	Edison.

ALTERNATING CURRENT MOTORS

SINGLE PHASE. 125-133 CYCLES.

1	¼	Holtzer-Cabot, 104 volts.
6	¼	Stanley, 50 volts.
5	¼	Stanley, 100-110 volts.
3	½	Stanley 100-110 volts.
1	1	Wagner, 208 volts, auto.
1	1½	Wagner, 208 volts, auto.
1	3½	Century, 104 volts, auto.
1	7½	Gen. Elec., 110 volts.

SINGLE PHASE. 60 CYCLE.

H.P.		
1	1	Emerson, 220 volts, self-start.
2	1	Wagner, 220 volts, auto.
1	2	Century, 208 volts, auto.
2	3	Century, 208 volts, auto.
1	5	Century, 208 volts, auto.
1	30	Wagner, 104 volts, auto.

THREE PHASE. 60 CYCLE.

2	1	Gen. Elec., 110 v.
2	2	Gen. Elec., 110 v.
2	2	Gen. Elec., 220 v.
1	3	Gen. Elec., 110 v.
2	5	Gen. Elec., 220 v.
1	30	Gen. Elec., 110 v.
1	40	Gen. Elec., 220 v.
1	50	Gen. Elec., 220 v.

ARC LAMPS

SPECIAL BARGAINS

500 Sterling enclosed 110 v. direct current. We can furnish these for indoor or outdoor service with globes or reflector shades. Above are *brand new.*

MOTOR GENERATORS, BOOSTERS

TELEPHONE RINGING GENERATORS, SETS, ETC.

K.W.		
2	¼	Crocker-Wheeler, Telephone Ringing Generator, 4 volt fields, giving 1 amp., 75 volts.
1	½	Perrett, self-oiler, 3 amp. 110 v. to 35 amp., 10 volt.
1	½	Crocker-Wheeler, 500 volts, direct to 110 volts alternating, for telephone ringing 17 cycles.
1	1	Crocker-Wheeler Dynamotor, 500 volts, d. c. to 6 volts, 35 amp., for electro-plating or telephone work.
1	2	Crocker-Wheeler, 8.9 amp., 110 v., to 35 amp., 18 v.
3	2	Crocker-Wheeler Dynamotor, 110 volts, 64 amp. to 6 volts, 90 amp. d. c., for electro-plating or telephone work.
1	3	Crocker-Wheeler, 110 volts, d. c. to 21 volts, 65-75 amp. d. c.
1	3	Western Electric, type H. H. Dynamotor. 110 volts direct to 6 volts, 150 amp., direct current, for electroplating or telephone work.

BARGAINS

Alternating and direct-current motors. Dynamos at bargain prices. Send in your requirements and we will be pleased to quote you. We buy, rent and install.

EUGENE L. RICHTER
1914 Columbia Ave.
PHILADELPHIA, PA.

FOR SALE

Two (2) Lighting Outfits complete, one (1) 600 lights and the other 1000 lights. These outfits would be just the thing for a small town.

The 600 light outfit consists of one (1) belt driven engine, 2,200 v. dynamo and instruments, all of Westinghouse manufacture. The 1,000 light outfit consists of one (1) Woodbury engine, 2,200 v. Westinhouse dynamo and instruments.

This will be a bargain, as it must be sold at once.

Address No. 2,097, care Electrical World and Engineer, New York.

FOR SALE

110 125-Volt Electrical Machinery. Immediate delivery.
One 200-K.W. Keystone Generator to 20 x 24 Atlas Engine, 175 R.P.M.
One C-C. Generator to 9 x 8 Fischer Engine, 325 R.P.M.
Two 40-H.P. Bullock compound motors, M. P.
One 25-H.P. Eddy compound motor, M. P.
Two 10-H.P. Eddy motors.
One 5-H.P. Lundell motor.
Two 3-H.P. Crocker-Wheeler motors, M. P.
Two 3-H.P. Quaker City motors.

YEARSLEY & LEVENE, 305 N. Third St., Phila., Pa.

WANTED

A 300 HP. right hand, Simple or Tandem Compound Steam Engine, in good condition, stroke, 24 to 36". FRANKLIN BOARD & PAPER CO, FRANKLIN, OHIO.

CAPITAL WANTED

Company, manufacturing electrical apparatus, desiring additional capital, offers exceptional opportunity for first-class investment. Fullest investigation courted. Address "Manufacturer," care of Electrical World and Engineer, 929 Court Street, Philadelphia, Pa.

FOR SALE

A well-established electrical supply business in New England. Pays well. Will sell on account of poor health. Address No. 2111, care of Electrical World and Engineer, New York.

110 to 125 VOLT APPARATUS
DIRECT CONNECTED UNITS

200-Kw. Keystone, 8-pole and 20x24 Atlas engine.
200-Kw. Thompson Ryan and McEwen tandem engine.
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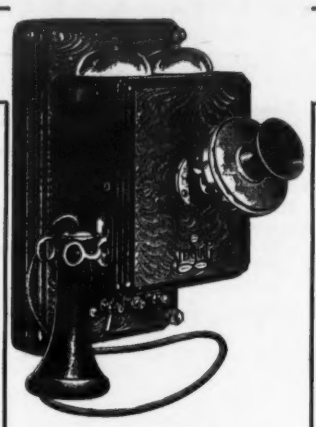
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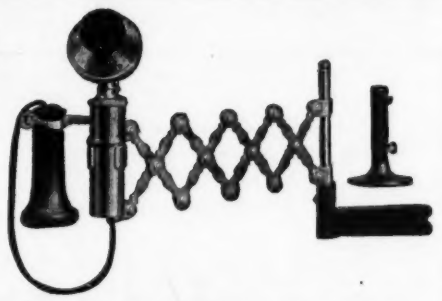

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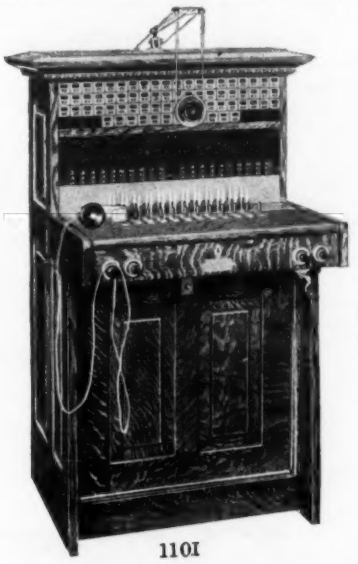

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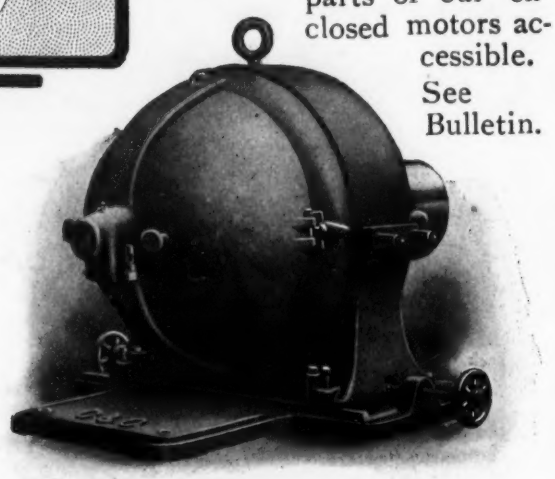

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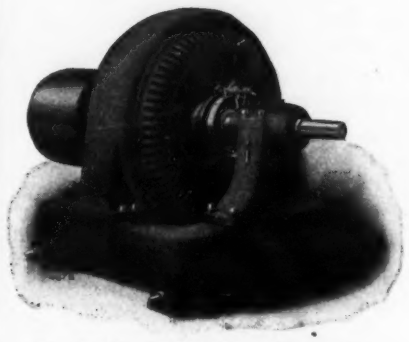

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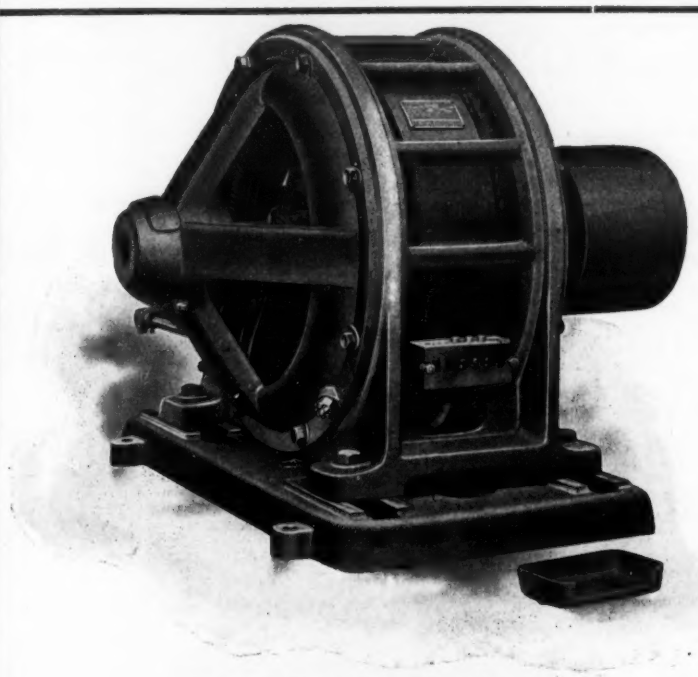

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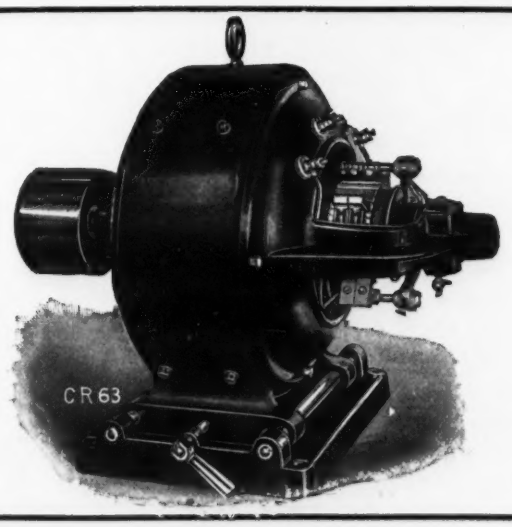

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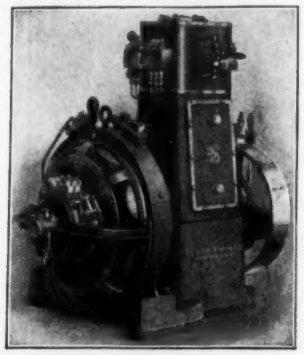

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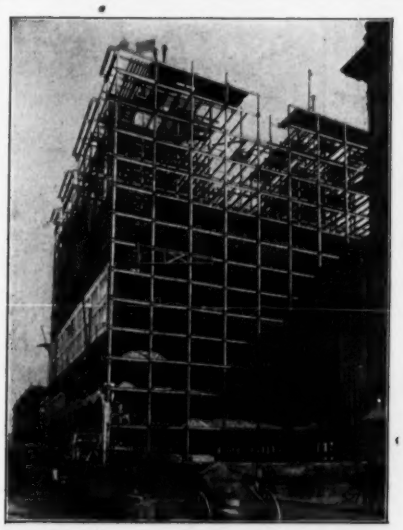

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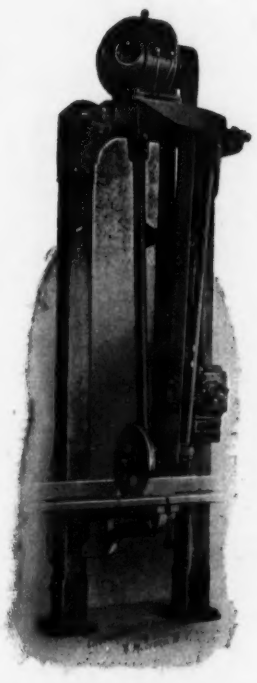

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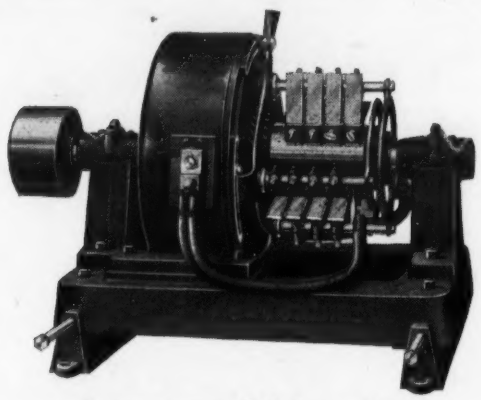

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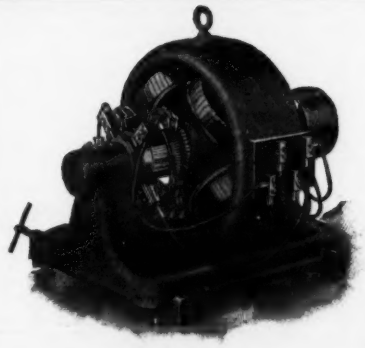

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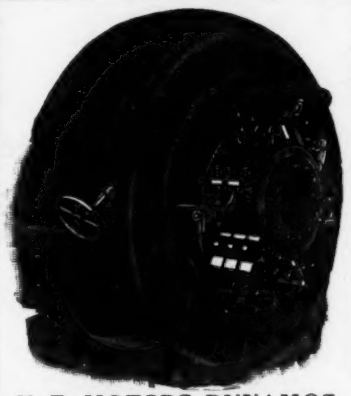

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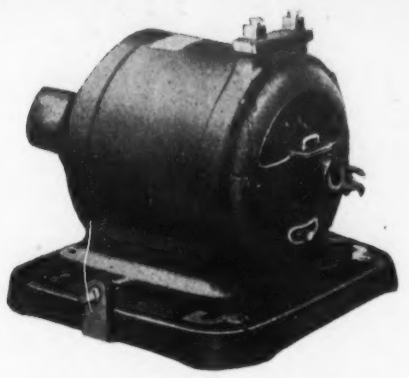

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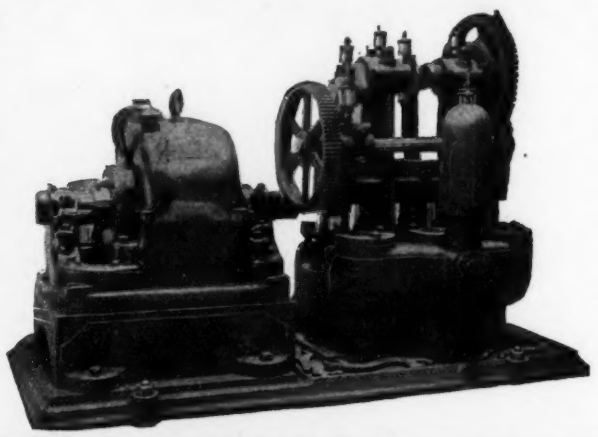

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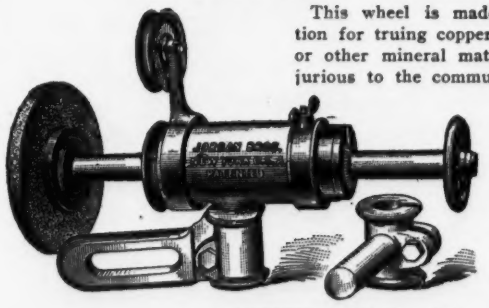

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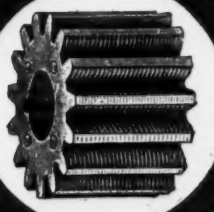

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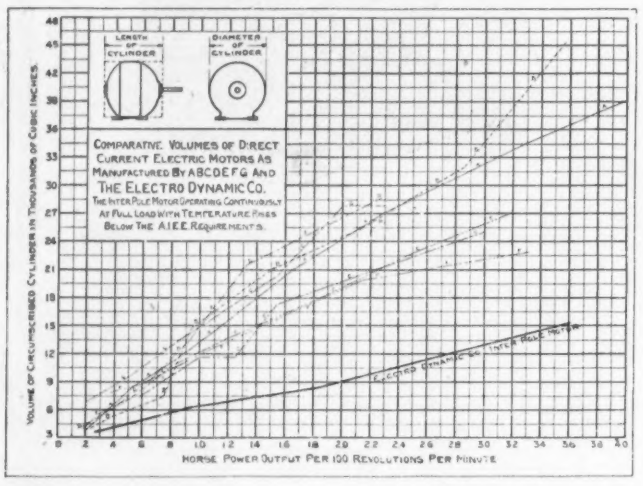
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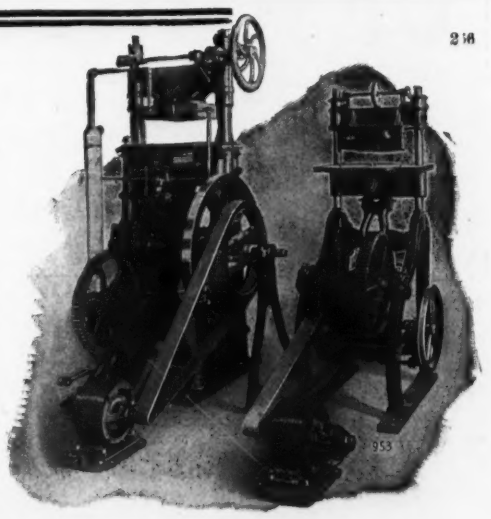

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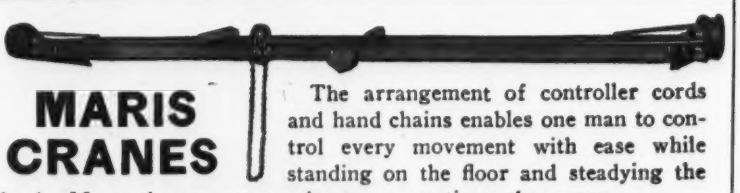

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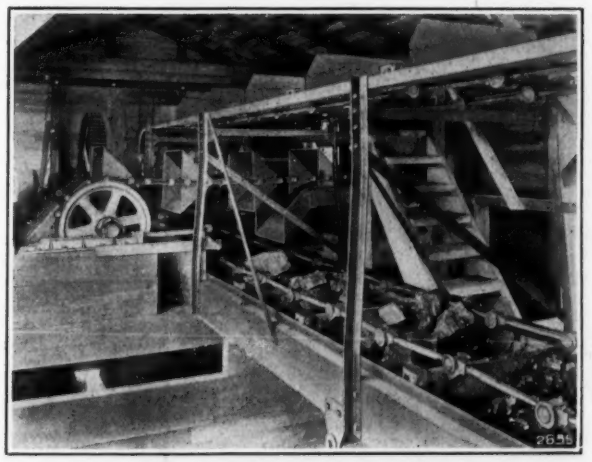

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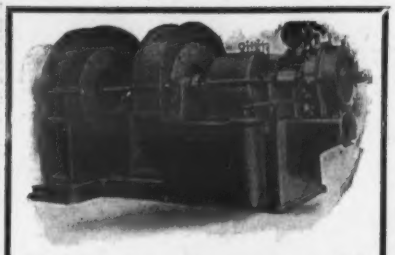

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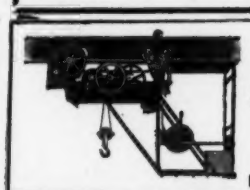

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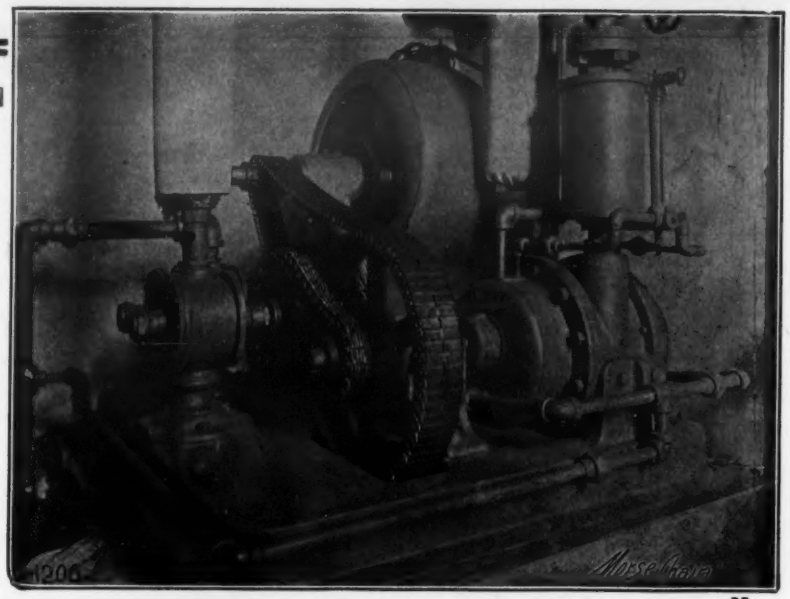

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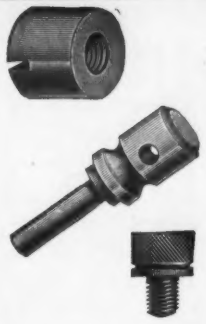

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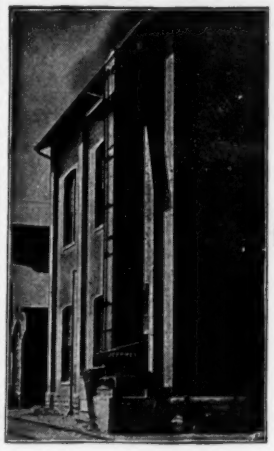

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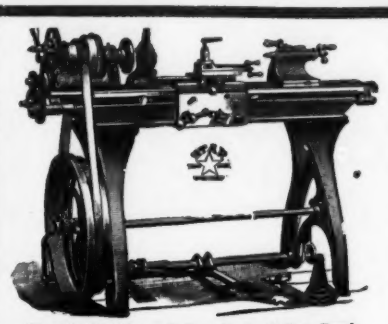

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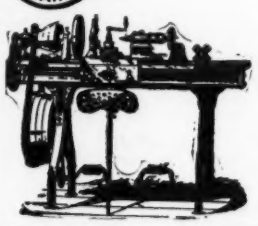

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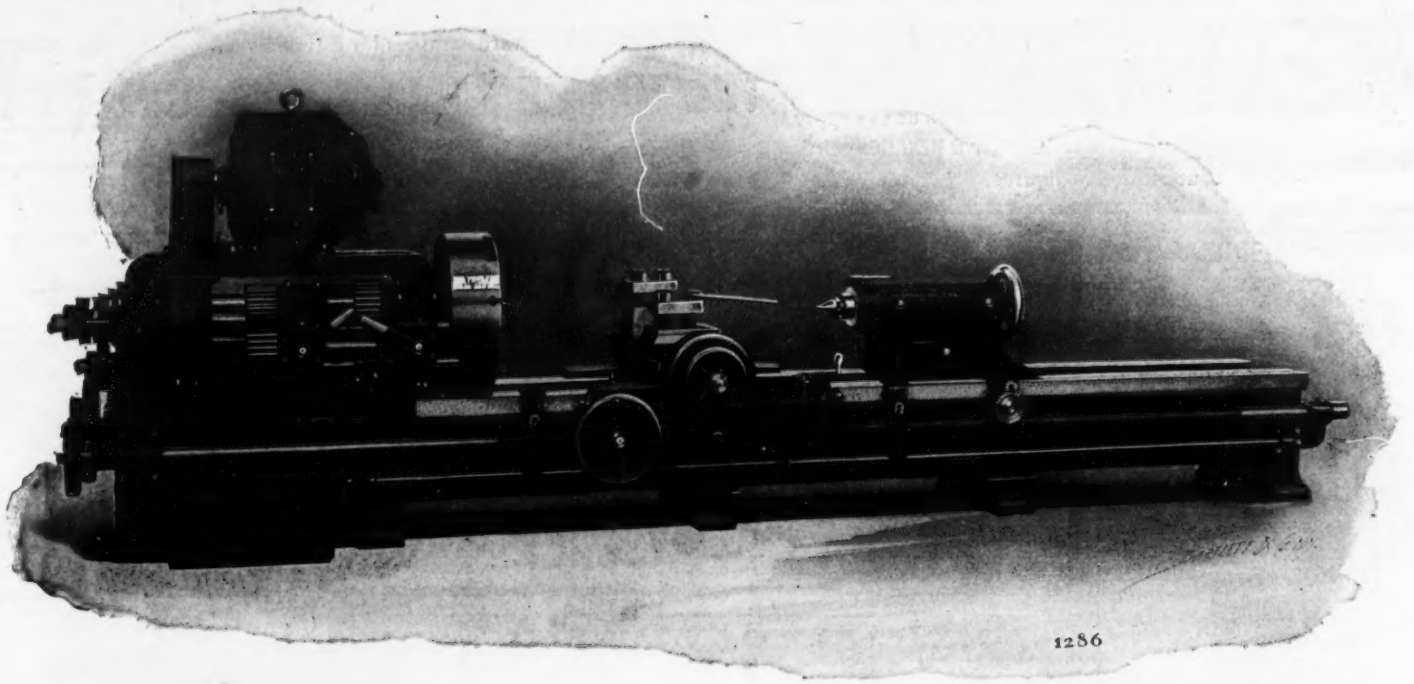

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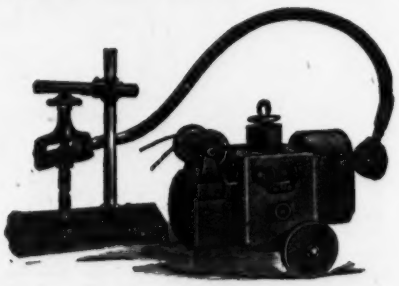

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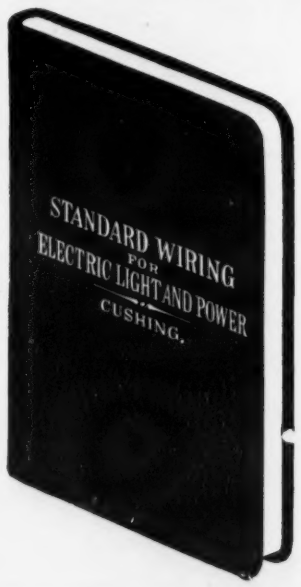

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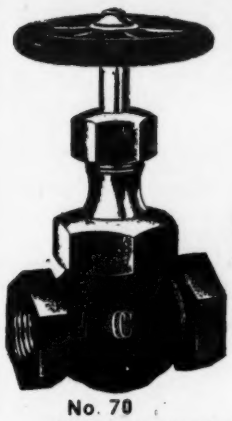

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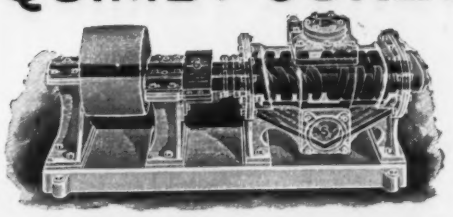

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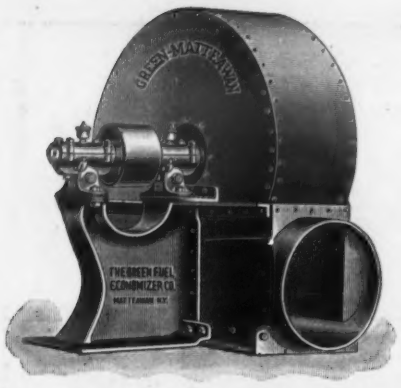

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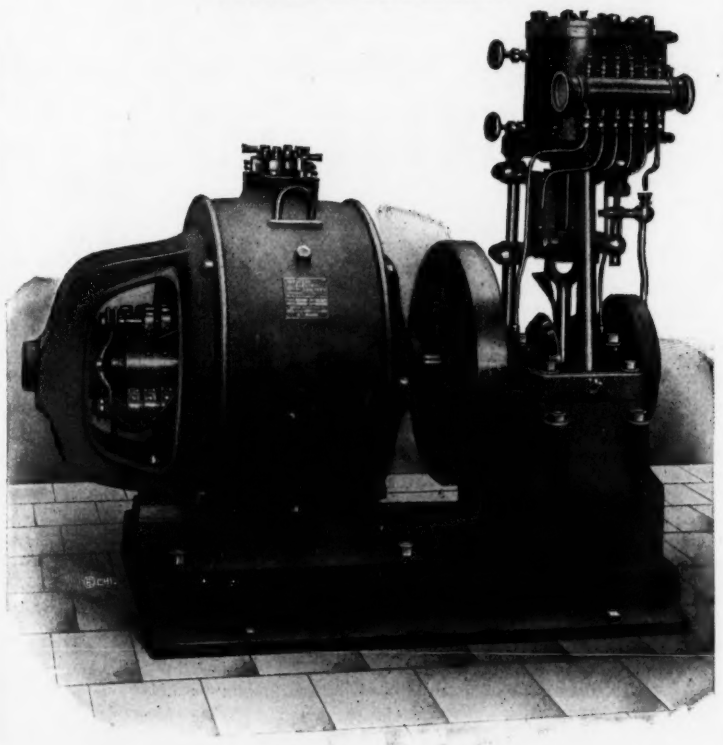

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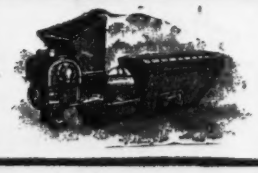

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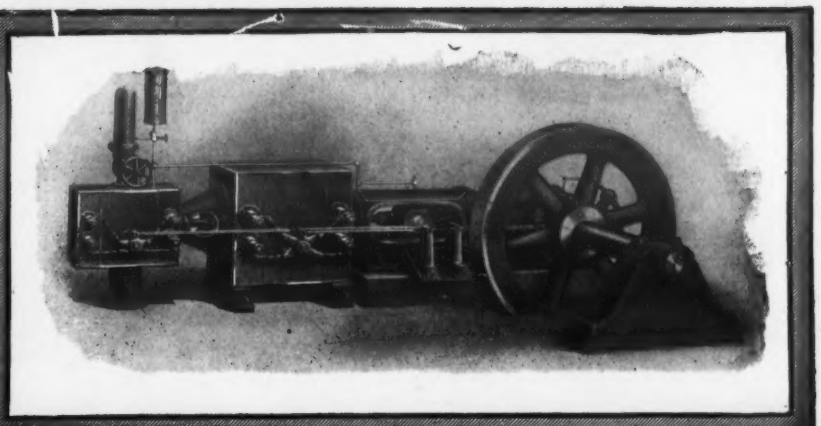

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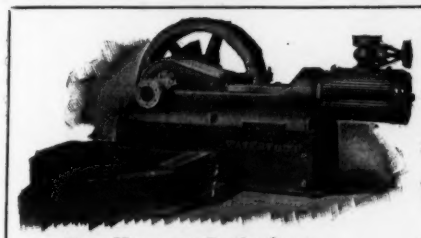

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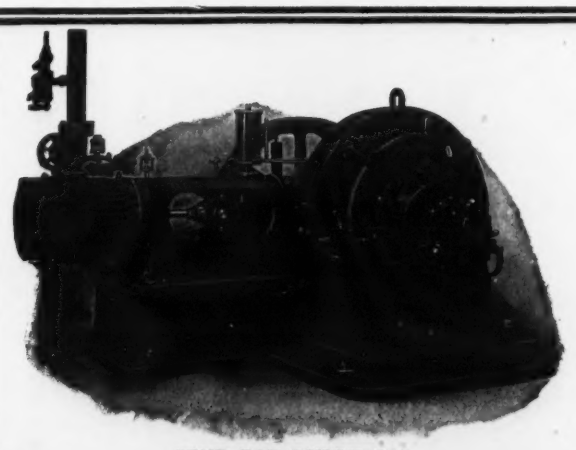

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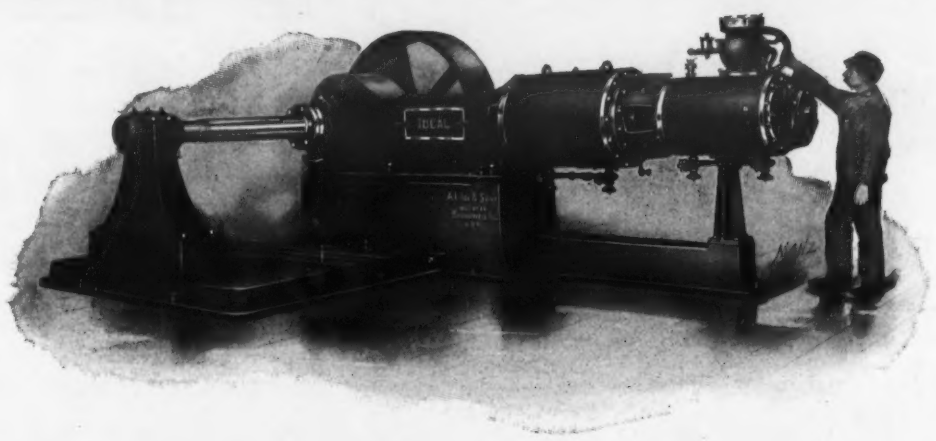

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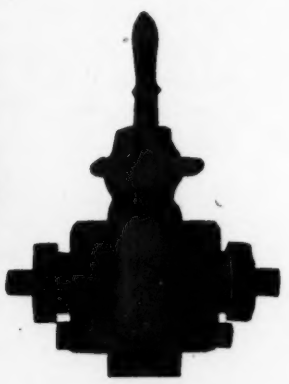

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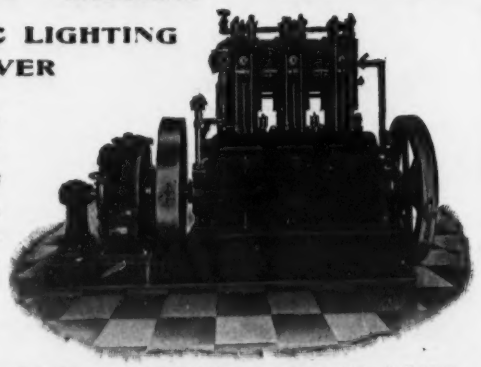

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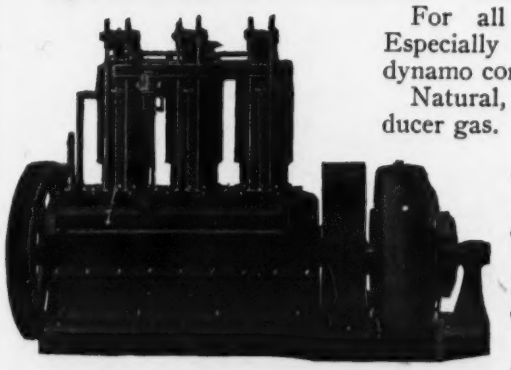

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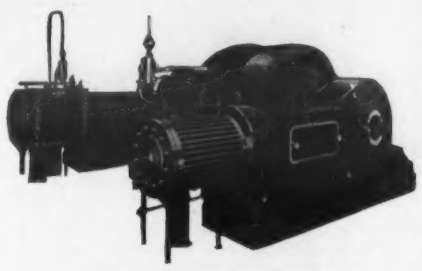

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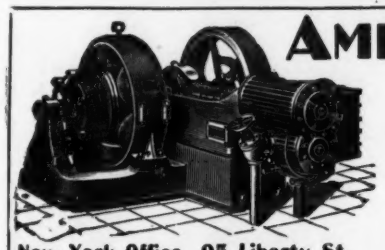

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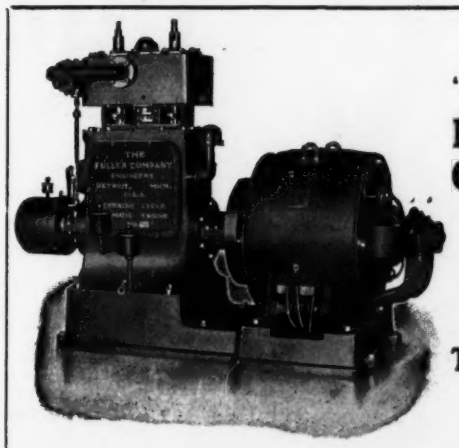

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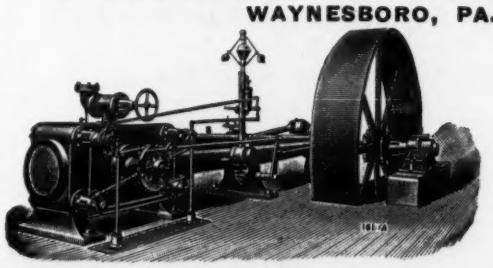

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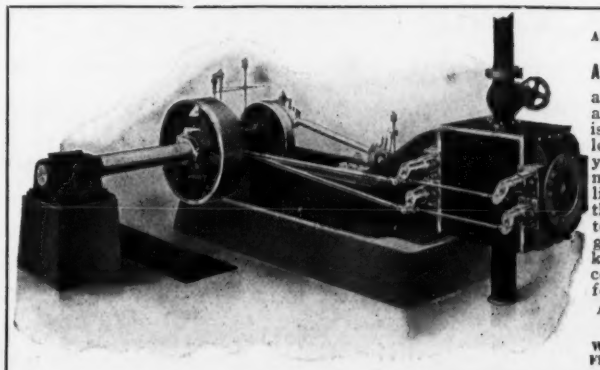

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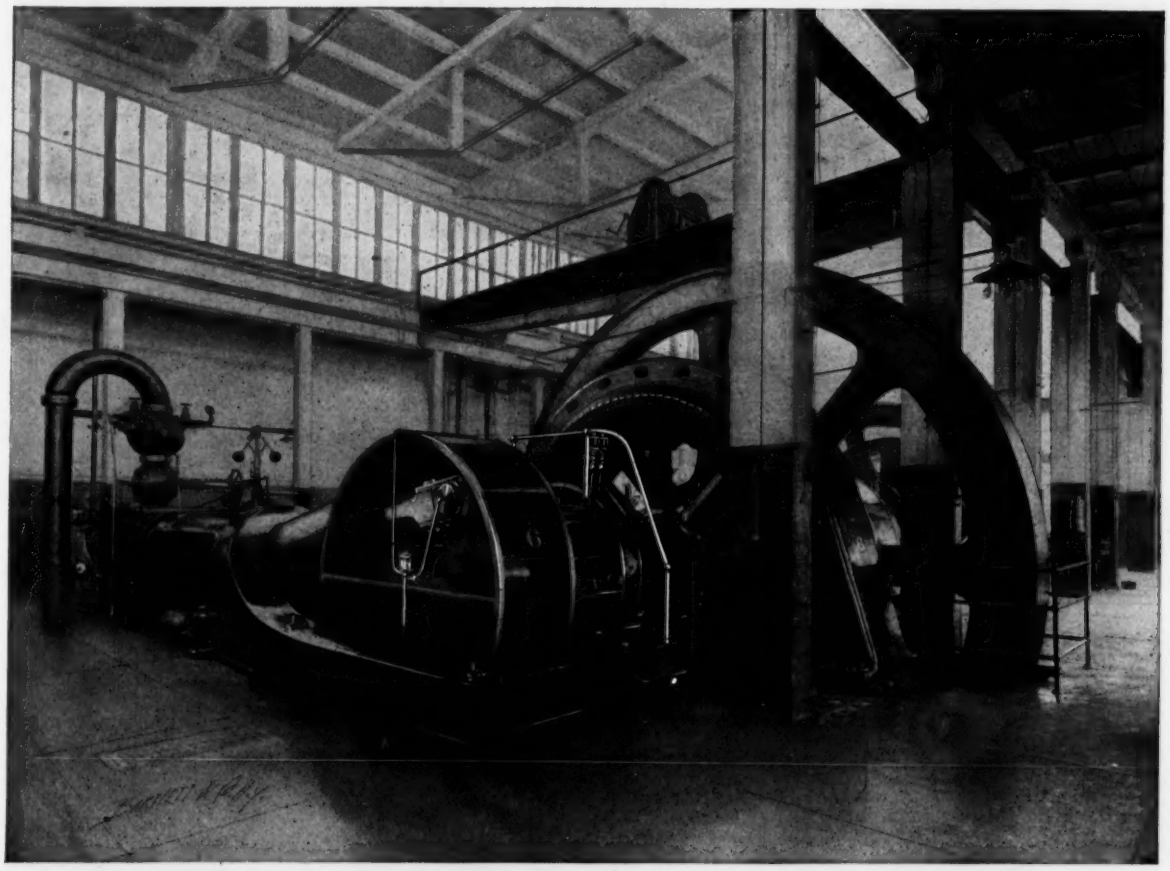

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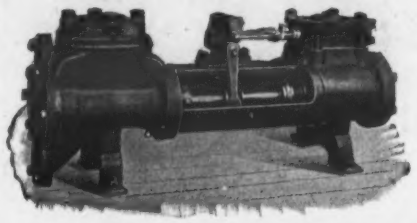

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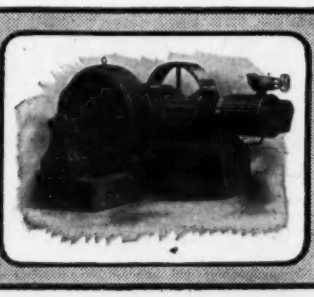

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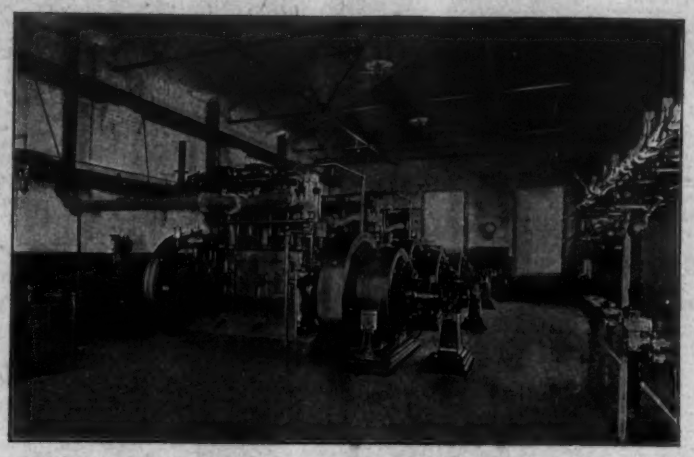

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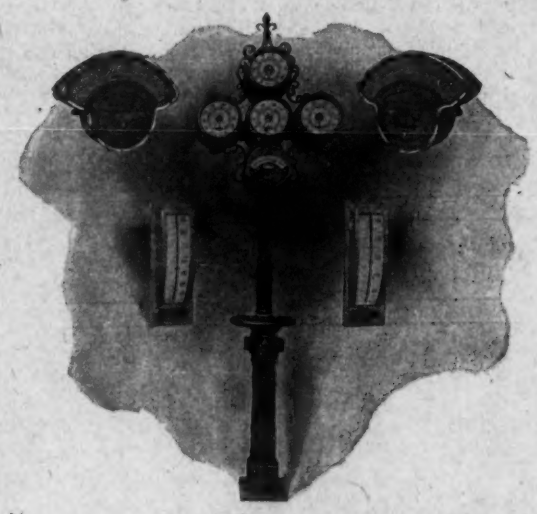

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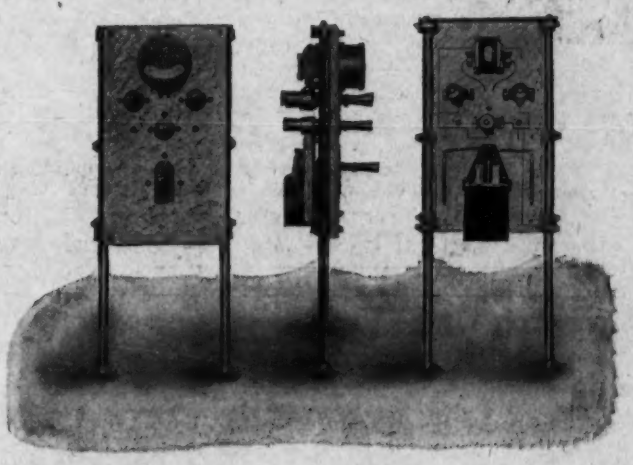

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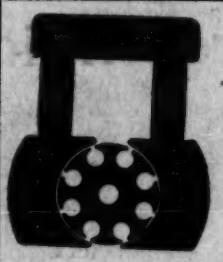

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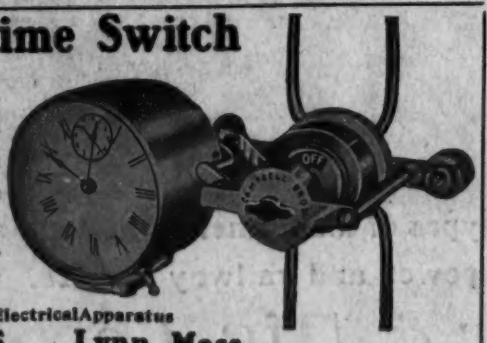

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